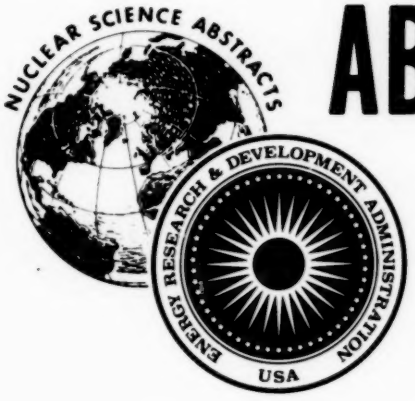
NUCLEAR SCIENCE ABSTRACTS



Volume 31 Number 11

Abstracts 28956-32460

June 15, 1975

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of ERDA and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, ERDA's Technical Progress Reviews, ERDA-sponsored translations, conference proceedings published by ERDA, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of ERDA reports in countries other than the United States are listed on the inside back cover.

ALABAMA
- Auburn, Auburn University
- Tuskegee Institute, Tuskegee Institute

ARIZONA
- Tucson, University of Arizona

CALIFORNIA
- Davis, University of California
- Los Angeles, University of California
- Santa Barbara, University of California

COLORADO
- Boulder, University of Colorado

DISTRICT OF COLUMBIA
- Washington, Library of Congress

FLORIDA
- Gainesville, University of Florida

GEORGIA
- Atlanta, Georgia Institute of Technology

HAWAII
- Honolulu, University of Hawaii

IDAHO
- Pocatello, Idaho State University

ILLINOIS
- Urbana, University of Illinois

INDIANA
- Lafayette, Purdue University

IOWA
- Ames, Iowa State University

KANSAS
- Manhattan, Kansas State University

KENTUCKY
- Lexington, University of Kentucky

MARYLAND
- Baltimore, Johns Hopkins University
- College Park, University of Maryland

MASSACHUSETTS
- Cambridge, Massachusetts Institute of Technology
- Worcester, Worcester Polytechnic Institute

MICHIGAN
- Ann Arbor, University of Michigan

MISSISSIPPI
- State College, Mississippi State University

MISSOURI
- Columbia, University of Missouri
- Kansas City, Linda Hall Library

NEW JERSEY
- Princeton, Princeton University

NEW MEXICO
- Albuquerque, University of New Mexico

NEW YORK
- Albany, New York State Library
- Albany, State University at Albany
- Ithaca, Cornell University
- New York, Columbia University
- Rochester, University of Rochester
- Syracuse, Syracuse University

NORTH CAROLINA
- Raleigh, North Carolina State University

OHIO
- Cincinnati, University of Cincinnati
- Cleveland, Cleveland Public Library
- Toledo, University of Toledo

OKLAHOMA
- Norman, University of Oklahoma

PENNSYLVANIA
- Philadelphia, University of Pennsylvania
- Pittsburgh, Carnegie Library
- University Park, Pennsylvania State University

PUERTO RICO
- San Juan, University of Puerto Rico

SOUTH CAROLINA
- Columbia, University of South Carolina

TENNESSEE
- Knoxville, University of Tennessee

TEXAS
- Austin, University of Texas
- College Station, Texas A & M University
- Houston, Rice University

UTAH
- Salt Lake City, University of Utah

VIRGINIA
- Blacksburg, Virginia Polytechnic Institute
- Charlottesville, University of Virginia

WASHINGTON
- Pullman, Washington State University
- Seattle, University of Washington

WEST VIRGINIA
- Morgantown, West Virginia University

WISCONSIN
- Madison, University of Wisconsin

ERDA reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

Volume 31, Number 11, June 15, 1975

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

Atomic Energy of Canada Limited
Australian Atomic Energy Commission
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
French Atomic Energy Commission
Japan Atomic Energy Bureau–Atomic Energy Research Institute
Commissie Nucleaire Informatieverzorging (Netherlands)
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

NSA is issued in two volumes per calendar year, one beginning January 15, the other July 15. Each volume consists of twelve issues.

For the two 12-issue volumes, the annual subscription rate is $121.05 for domestic subscribers and $151.35 for foreign subscribers. A single issue costs $5.05 domestic rates or $6.26 foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

Indexes are cumulated for each volume, i.e., on a six-month volume basis. If purchased on an annual subscription basis the two volume indexes are priced at $44.40 for domestic subscribers and $55.50 for foreign subscribers.

The volume indexes are also sold separately. Each volume index is priced on the basis of pagination at the time of publication.

Previous *NSA* cumulative indexes are available:

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:

Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830:

Vols. 5–10, Subjects and Authors (1951–1956), $5.25.
Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:

Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.
Vol. 26, Subjects and Authors (1972), $37.75
Vol. 27, Subjects, Authors, and Report Numbers (Jan.–June 1973), $16.90.
Vol. 28, Subjects and Authors (July–Dec. 1973), $18.55.
Vol. 29, Subjects and Authors (Jan.–June 1974), $20.10.
Cumulative Report Number Index, Vols. 1–15 Revised, $4.00.
Cumulative Report Number Index, Vols. 16–20 Revised, $5.50.
Cumulative Report Number Index, Vols. 21–28, $9.35.

From Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106:

Vols. 21–25, Subjects, Authors, and Corporate Authors (1967–1971), $195.00.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Science Abstracts is also available on 16-mm and 35-mm microfilm in reel or cartridge from Princeton Microfilm Corporation, Alexander Road, Princeton, New Jersey 08540. The cost of Vols. 1–26 (1948–1972) including *Abstracts of Declassified Documents* (1947–1948) is $730.00. The indexes for *Nuclear Science Abstracts* Vols. 1–26 (1948–1972) are also available for $385.00. The cost of each volume (six months) of *NSA* and its indexes is $45.00.

INDEXES TO *NSA*

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

CARTER, G., See REED, D.J., 30:21824
CASA, A.F., Nuclear energy in Japan, 30:23243
CASARETT, A.P., See KALLFELZ, F.A., 30:21411
CASCI, C., Method for preliminary analysis of MHD generator performance, 30:20916 (AGARD-CP-104)

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTOR CONTROL SYSTEMS/PERFORMANCE
Optimization of control-rod programming in multiregion nuclear reactors, 30:23184
REACTOR COOLING SYSTEMS/TRANSIENTS
WFLASH: a FORTRAN-IV computer program for simulation of transients in a multi-loop PWR, 30:23171 (WCAP-8261(Rev.1))
REACTOR CORES/INSPECTION
Initial results of a holographic tomosynthesis technique for fuel-core inspection, 30:23198
REACTOR CORES/STRESS ANALYSIS
Methods of stress analysis in use at General Atomic for core design (HTGR graphite moderator), 30:23078 (GA-A-12870)

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

23214 (HEDL-TME-74-16) ANALYSIS OF TEMPERATURE PROFILES IN TRANSIENTLY HEATED UO_2 USING MOLYBDENUM INCLUSIONS. Wilmot, E. L. **(Hanford Engineering Development Lab., Richland, Wash. (USA)).** [nd]. Contract AT(45-1)-2170. 23p. AT.

is indexed as:

HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH. (USA)
Analysis of temperature profiles in transiently heated UO_2 using molybdenum inclusions, 30:23214 (HEDL-TME-74-16)
HEDL quarterly technical report, January--March 1974. Volume I. Materials technology, 30:21815 (HEDL-TME-74-1(Vol.1))
Modeling of the post-irradiation fuel-cladding gap in mixed-oxide fuels, 30:23103 (HEDL-TME-74-19)
Preliminary data report: post-irradiation examination of fuel pins PNL-10-23 and PNL-10-63, 30:23149 (HEDL-TME-74-23)
Prototype applications loop two years of operation, 30:20928 (HEDL-TME-74-24)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

SU-IPR-		
518	30:22074	See N-74-15472
SZS-	**(F.R. Germany)**	
154	30:22967	Dep. NTIS (US Sales Only), $4.75
156	30:21178	Dep. NTIS (US Sales Only), $4.25
158	30:21359	Dep. NTIS (US Sales Only), $4.25
159	30:20815	Dep. NTIS (US Sales Only), $4.75
160	30:21360	Dep. NTIS (US Sales Only), $5.75
TID-		
3910(Suppl.9)	30:21128	Dep. NTIS, $5.45
26580	30:23377	Dep. NTIS, $9.25
26595	30:21670	Dep. NTIS, $4.00

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 31, Number 11, June 15, 1975

Category	*Page*
CHEMISTRY	2903
Analytical and Separations Chemistry	2903
Activation and Nuclear Reaction Procedures	2903
Chemical and Spectral Procedures	2906
Radiometric and Radiochemical Procedures	2908
Separation Procedures	2909
Inorganic, Organic, and Physical Chemistry	2911
Chemical and Physicochemical Properties	2911
Isotope Effects	2912
Isotope Exchange and Isotope Separation	2914
Feed Materials Processing	2915
Radiation Chemistry	2915
Radiochemistry and Nuclear Chemistry	2921
Hot-Atom Chemistry	2921
Properties of Radioactive Materials	2921
Radioactive Waste Treatment	2925
Radioisotope Production	2926
Reactor Fuel Reprocessing	2927
CONTROLLED THERMONUCLEAR RESEARCH	2930
Plasma Confinement and Heating	2930
Plasma Diagnostics	2932
Plasma Kinetics (General)	2934
Plasma Kinetics (Experimental)	2935
Plasma Kinetics (Theoretical)	2935
Plasma Production	2936
Plasma Stability	2937
Thermonuclear Engineering and Equipment	2938
Wave Phenomena	2941
ENGINEERING	2943
Energy Conversion	2943
Facilities and Equipment	2943
Lasers	2950
Cryogenic and Superconducting Equipment and Devices	2956
Heat Transfer and Fluid Flow	2958
Materials Testing	2960
Nuclear Explosions	2962
Protective Structures and Equipment	2964
Safety Engineering	2965
Vacuum Engineering	2965
ENVIRONMENTAL AND EARTH SCIENCES	2966
Minerals and Ores	2966
Radioactive Effluents	2967
Radioactivity Monitoring and Transport	2968
Atmosphere	2969
Soil	2970
Water	2970
Ecosystems and Food Cycles	2971
Radiometric Techniques	2972
Site Surveys	2973
Thermal Effluents	2974
Chemical Effluents	2975

Category	*Page*
INSTRUMENTATION	2976
Radiation Detection Instruments	2976
General Detectors and Monitors	2976
Radiation Dosimeters	2980
Nuclear Spectroscopic Instrumentation	2980
High Energy Physics Instrumentation	2982
Radiometric Instruments	2982
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	2983
Miscellaneous Instruments	2984
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	2986
Isotope Separation (Industrial)	2986
Isotopic Power Sources	2987
Radiation Sources	2987
Design and Fabrication	2987
Industrial Uses	2987
LIFE SCIENCES	2990
Radiation Effects on Biochemicals	2990
Radiation Effects on Cells	2991
Radiation Effects on Microorganisms	2992
Radiation Effects on Plants	2995
Radiation Effects on Animals	2997
Man	2997
Vertebrates	3003
Invertebrates	3007
Radionuclide Effects (Internal Source)	3008
Man	3008
Animals	3009
Microorganisms	3010
Nuclide Kinetics and Toxicology	3010
Man	3010
Animals	3010
Plants	3012
New Tracer Techniques	3012
MATERIALS	3022
Ceramics and Cermets	3022
Metals and Alloys	3027
Corrosion and Erosion	3027
Preparation and Fabrication	3029
Properties, Structure, and Phase Studies	3030
Radiation Effects	3040
Other Materials	3044
NUCLEAR MATERIALS AND WASTE MANAGEMENT	3048
Accountability and Safeguards	3048
Disposal and Storage	3048
Handling Equipment and Procedures	3050
Transportation	3051

TABLE OF CONTENTS (continued)

Category	Page
PARTICLE ACCELERATORS	3052
Design, Development, and Operation	3052
Auxiliaries and Components	3054
Ion Sources and Injection and Extraction Systems	3055
Ion Optics and Field Calculations	3055
Storage Rings	3055
Experimental Facilities	3056
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	3058
Cosmic Radiation	3058
Stars	3061
Quasi-Stellar, Radio, and X-Ray Sources	3071
Solar Phenomena	3075
Galaxies	3080
Cosmology	3085
Planetary Phenomena	3086
PHYSICS (ATMOSPHERIC)	3088
Auroral and Ionospheric Phenomena	3088
Magnetospheric Phenomena	3090
PHYSICS (ATOMIC AND MOLECULAR)	3092
Beams and Their Reactions	3092
Atomic and Molecular Properties	3094
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	3096
Collision Phenomena	3096
Atomic Theory	3101
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	3102
PHYSICS (HIGH-ENERGY)	3103
Particle Interactions and Properties (Experimental)	3103
Electromagnetic	3103
Weak	3104
Strong (Baryon-induced)	3105
Strong (Meson-induced)	3108
Particle Interactions and Properties (Theoretical)	3109
General	3109
Electromagnetic	3110
Weak	3113
Strong (General)	3115
Strong (Baryon No. = 0)	3116
Strong (Baryon No. = 1)	3117
Strong (Baryon No. ≥ 2)	3118
Particle Invariance Principles and Symmetries	3120
General	3120
Applications (Electromagnetic and Weak)	3120
Applications (Strong)	3121
Scattering Theory	3121
PHYSICS (LOW-TEMPERATURE)	3123
Superfluidity	3123
Superconductivity	3136
PHYSICS (NUCLEAR)	3139
Neutron Interactions with Matter	3139
Nuclear Properties and Reactions, $A \leq 5$	3141
Nuclear Properties and Reactions, $6 \leq A \leq 19$	3142
Nuclear Properties and Reactions, $20 \leq A \leq 38$	3145
PHYSICS (NUCLEAR) (Cont'd.)	
Nuclear Properties and Reactions, $39 \leq A \leq 58$	3147
Nuclear Properties and Reactions, $59 \leq A \leq 89$	3149
Nuclear Properties and Reactions, $90 \leq A \leq 149$	3151
Nuclear Properties and Reactions, $150 \leq A \leq 189$	3156
Nuclear Properties and Reactions, $190 \leq A \leq 219$	3157
Nuclear Properties and Reactions, $A \geq 220$	3159
Nuclear Theory	3163
PHYSICS (RADIATION AND SHIELDING)	3169
Radiation Physics	3169
Radiation Protection Standards	3171
Radiation Source Calibration and Standardization	3171
Shielding Calculations and Experiments	3171
PHYSICS (THEORETICAL)	3172
General	3172
Quantum Field Theories	3173
Gravitation and General Relativity	3177
REACTOR TECHNOLOGY AND REGULATION	3179
Power Reactors, Non-Breeding, BWR-Type	3179
Power Reactors, Non-Breeding, PWR-Type	3180
Power Reactors, Non-Breeding, Graphite Moderated	3181
Power Reactors, Non-Breeding, Otherwise Moderated	3185
Power Reactors, Breeding	3185
Research, Test, and Experimental Reactors	3190
Production and Materials Testing and Processing Reactors	3191
Propulsion and Package Reactors	3191
Reactor Safety and Environmental Aspects	3216
Reactor Theory and Calculation	3223
Reactor Components and Accessories	3224
Reactor Fuels	3227
Reactor Control Systems	3228
Nuclear Power Plant Economics	3231
Reactor Fuel Cycle Economics	3231
Reactor Licensing and Regulation	3231
GENERAL AND MISCELLANEOUS	3234
Civilian Defense	3234
Energy Utilization and Economics	3234
Information Handling	3234
Law	3234
Management	3235
Mathematics and Computers	3236
Miscellaneous	3237
Chemistry	3237
Life Sciences	3238
Materials	3239
Physics and Engineering	3242
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-20
SUBJECT INDEX	INDEX-76
REPORT NUMBER INDEX	INDEX-226

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Assistant Editor
Lee M. Thompson

Associate Editors
M. Catherine Grissom
Robert C. Kelly
Sidney F. Lanier
Henry D. Raleigh
Charles E. Stuber

Report Evaluators
John H. Mitchell
Mary H. Newman

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Dora H. Moneyhun

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Information Specialists
P. Martin Alexander
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Stanley D. Frey
Darrell O. Galde
Martha W. Gerrard
Everett J. Hoffman
Carolyn D. Houston
Lynda H. Kern
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Lorne T. Newman
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Stanley J. Rimshaw
Jessie W. Rushing
Robert W. Rutkowski
Francis S. Sachs
Lila B. Smith
Polly C. Summers
Helen L. Ward
Lawrence T. Whitehead
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Noboru Kawakami

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 31, Number 11 June 15, 1975

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Activation and Nuclear Reaction Procedures

28956 (DP-MS-74-50) AUTOMATED ABSOLUTE ACTIVATION ANALYSIS. Bowman, W. W.; MacMurdo, K. W. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 42p. (CONF-750305-1). Dep. NTIS $5.25.

From conference on analytical chemistry; Pittsburgh, Pennsylvania, USA (3 Mar 1975).

The ^{252}Cf Activation Analysis Facility at Savannah River Laboratory is routinely used for multielement analysis of a wide variety of solid and liquid samples. In order to maximize sample throughput, a technique termed Automated Absolute Activation Analysis has been developed which provides qualitative and quantitative analyses without simultaneously analyzing comparative standards, preparing working curves, or using flux monitors. The current facility centers around a large (12 mg) ^{252}Cf source surrounded by 18 irradiation tubes with light water as the moderator. From the known neutron energy distribution and measured disintegration rate of the ^{252}Cf source, the neutron spectrum may be calculated for any source/moderator/sample configuration. By combining the results of the gamma-ray spectrum analysis with the irradiation timing information, spectrometric decay data, detector efficiencies, and the specific neutron capture reaction rates, the elemental composition of the sample is calculated. Because the neutron spectrum is predictable and cross section data are available, comparative standards, flux monitors, and/or working curves are not necessary. Measured and calculated neutron fluxes for various sample locations agree within 3%; measured and calculated specific neutron capture rates agree within 10%. In the current facility, 52 elements have interference-free detection limits below 10 ppm. The results of analyses of known standards (NBS and USGS) and solutions indicate overall accuracies of better than ±15% for most elements. The limits of applicability of the technique will be discussed with reference to the various samples analyzed to date. (auth)

28957 (KFKI-75-3) NEUTRON ACTIVATION ANALYSIS OF AIRBORNE INORGANIC POLLUTANTS. Oerdoegh, M.; Kalman, L. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 21p. Dep. NTIS (US Sales Only) $4.25.

One of the most suitable methods to analyze air pollution is the gamma-spectrometry by a Ge(Li) detector with high resolution connected to a multichannel analyzer. The aim of our studies was to determine the radioactive and non-radioactive pollution of the air in the environment of the atomic reactor WWR-S of the Hungarian Academy of Sciences. Accordingly the investigations were carried out by two ways: the samples were analyzed partly without previous irradiation and partly by neutron activation analysis. The use of several filter papers was studied and the most suitable filter paper (Whatman No. 41) was chosen for this investigation. The quantitative determination of more than twenty elements has been performed. First the natural activity of the aerosol samples taken periodically was measured and subsequently they have been analyzed after irradiation in the atomic reactor for 1 minute, 1 hour, and 50 hours, respectively. A 45-cm^3 Ge/Li detector (Nuclear Diodes) was used in connection to a 1024 channel analyzer (type NTA-512B). The analyses were made nondestructively, and the gamma spectra were evaluated by computer. (auth)

28958 (NIM-1691) DETERMINATION OF ZIRCONIUM AND ALUMINIUM BY 14-MeV NEUTRON-ACTIVATION ANALYSIS. Pearton, D. C. G.; Eddy, B. T.; Bibby, D. M. (National Inst. for Metallurgy, Johannesburg (South Africa)). 10 Feb 1975. 18p. Dep. NTIS (US Sales Only) $4.00.

Aluminium and zirconium were determined in alloys, slags, and fumes by 14-MeV neutron activation analysis. After corrections for density variations and mutual interferences had been made, the data agreed well with those obtained by chemical analysis, precisions of less than 1.8% being obtained. The method is capable of a through-put of 10 to 12 samples, in duplicate, per man-day, and is nondestructive. (auth)

28959 ACTIVATION ANALYSIS OF BIOLOGICAL MATERIAL WITH RUTHENIUM AS A MULTI-ISOTOPIC COMPARATOR. van der Linden, R.; de Corte, F.; Hoste, J. (Ghent Rijksuniversiteit). Anal. Chim. Acta; 71: No. 2, 263-275(Aug 1974).

The elements Fe, Zn, Rb, and Co were determined in NBS bovine liver (SRM 1577) by nondestructive activation analysis; ruthenium was used as a triple comparator element by measuring the produced ruthenium-97, ruthenium-103, and ruthenium-105 activities. The results were in excellent agreement with the values of the analysis certificate and with those of an analysis based on a multi-element serum standard. The conclusions of the error theory of the comparator method were experimentally confirmed. (NL)

28960 OXYGEN CONTENT OF $\alpha-Si_3N_4$ SINGLE CRYSTALS. Kijima, K.; Kato, K.; Inoue, Z.; Tanaka, H. (National Inst. for Researches in Inorganic Materials, Sakura, Ibaraki, Japan). J. Mater. Sci.; 10: No. 2, 362-363(Feb 1975).

Single crystals of $\alpha-Si_3N_4$ were prepared by chemical vapor deposition in a graphite susceptor using a mixture of $SiCl_4$, N_2 and H_2 gases, and were examined for oxygen content by 14-MeV neutron activation analysis. One of the well-developed single crystals was also examined by x-ray diffraction. It is concluded that $\alpha-Si_3N_4$ is a polymorph of Si_3N_4, not a kind of oxynitride as proposed by Wild et al. [Special Ceramics 5, edited by P. Popper (British Ceramic Research Association, Stoke-on-Trent, 1972) pp 271, 385]. (UK)

28961 PHOTON ABSORPTIOMETRY AND SKELETAL MASS IN THE TREATMENT OF OSTEOPOROSIS. Aloia, J. F.; Ellis, K.; Zanzi, I.; Cohn, S. H. (Nassau County Medical Center, East Meadow, NY). J. Nucl. Med.; 16: No. 3, 196-199(Mar 1975).

Thirty-six osteoporotic patients who underwent several therapeutic regimes were studied on two occasions by photon absorptiometry and total-body neutron activation analysis (TBNAA). These determinations were made at a mean interval of 8.9 ± 0.8 months. The 8-cm radial site was chosen for the photon absorptiometry which was performed with the Norland-Instruments Densitometer. Mean initial bone mineral content (BMC) was 0.724 ± 0.069 gm/cm and mean bone width was 1.235 ± 0.072 cm. The mean percent change in BMC (%ΔBMC) was 1.02 ± 4.2. The initial total-body calcium (TB-Ca) as determined by TBNAA was reduced when compared with values that would be expected from empirically derived formulas. The mean percent change in Tb-Ca (%ΔTB-Ca) was −3.2 ± 4.7. Most patients displayed a change in BMC and TB-Ca that was at least 2 s.d. greater than the precision of the methods used (%ΔTB-Ca > 2). No relationship was found between the ΔBMC and the ΔTB-Ca (r = 0.17). These findings suggest that changes in the radial BMC at the 8-cm site cannot be extrapolated to indicate changes in

skeletal mass in response to treatment of osteoporosis. Whether photon absorptiometry at other sites or at multiple sites provides a closer relationship to changes in skeletal mass (TB-Ca) remains to be determined. (auth)

28962 CONTRIBUTION TO THE DETERMINATION OF CARBON IN Na BY GAMMA ACTIVATION. Nordmann, F.; Engelmann, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Analyses et d'Etudes en Chimie Nucleaire et Isotopique); Tinelli, Gerard (Ecole Superieure de Chimie, 68 - Mulhouse (France)). Analusis; 2: No. 10, 739-745(Nov 1974). (In French).

The activation curves and the region in which Na does not interfere in carbon determination were established. It results from these curves that the determination of C traces is only possible at irradiation energies lower than 38 MeV. Calibration curves were established and the application of an internal calibration method was investigated. The ^{11}C chemical separation method enabling the determination of C traces is described. Some analytical results are given, the carbon content of purified Na being 0.25μg/g. This appears to be the first reported determination of such a low C content in Na. (FR)

28963 NEUTRON-ACTIVATION ANALYSIS OF PURE ETHANOL. Sukhanovskaya, A. I. Tr., Vses. Nauch.-Issled. Inst. Khim. Reaktivov Osobo; No. 34, 135-141(1972). (In Russian).

In the method described for determining Au, Mn, Ni, Co, Cu, Zn, Fe, As and P, the sample (1 g) is irradiated (in a silica ampoule cooled by liquid N) for 20 hr. in a flux of ≈1.2×10^{13} neutrons/cm^2/sec. Suitable standards are similarly irradiated. The irradiated sample is transferred to a flask containing $HClO_4$–HNO_3 (1 : 5), carriers are added, and the mixture is heated under reflux for 10 min, then evaporated to dryness to oxidize organic matter. A solution of the residue in 0.1N HCl is extracted with ethyl ether to remove Au^{III} (as $HAuCl_4$), the extract is evaporated, and the residue is dissolved in 0.1N HCl. The aqueous solution remaining from the extraction of Au is adjusted to pH 5 to 6, then Fe, Mn, Ni, Co, Cu, and Zn are extracted (as diethyldithiocarbamate complexes) into $CHCl_3$. The $CHCl_3$ extract is evaporated with aqua regia, and a solution of the residue in 10N HCl is applied to an ion-exchange column, from which Ni and Mn are eluted with 10N HCl, Co with 4N HCl, Cu with 3N-HCl, Fe with 1.5N HCl, and Zn with H_2O. The eluate containing the Ni and Mn is concentrated, its pH is adjusted to 8 to 9, the metals are extracted into ethyl acetate as their diethyldithiocarbamate complexes, and the Mn complex is back-extracted into 2N HCl. The separate solution containing Ni and Mn are evaporated to dryness, and each residue is dissolved in acid. From the series of aqueous solutions obtained, Au, As, and P are isolated by using tetraphenylarsonium chloride, Fe with cupferron, Mn with 2-thenoyltrifluoroacetone and Zn, Co, Ni and Cu with diethyldithiocarbamate, and the radioactivities of the extracts are measured. The sensitivities (parts per 10^9) are, for P, Fe and Ni, 1; for Zn and Co, 0.1; for Cu, 0.01; and for As, Mn and Au, 0.0001. (Anal. Abstr.)

28964 COMPARISON OF ACTIVATION ANALYSIS WITH OTHER METHODS OF TRACER ANALYSIS. Obrusnik, I. (Ustav Jaderneho Vyzkumu, Rez, Czech.); Kotas, P. Radioisotopy; 15: No. 6, 863-876(1974). (In Czech).

From conference on instrumental activation analysis; Marianske Lazne, Czech. (3 Jun 1974).

When choosing an analytical method for the practical determination of a certain element, not only its sensitivity should be taken into account but also a number of other criteria depending on the specific conditions of analysis. It is often necessary to make a compromise between the ideal analytical technique and the requirements really achievable under given circumstances. The possibilities of activation analysis are discussed in comparison with some other methods of elemental analysis, as e.g., mass spectrometry, x-ray fluorescence spectrometry, atomic absorption spectrometry, spectrophotometry, polarography, etc. Finally, the individual methods of activation analysis are compared. The comparison is made with regard to sensitivity, number of simultaneously determinable elements, selectivity, speed of analysis, etc. The costs of the individual methods are compared too. (auth)

28965 USE OF THE (n,γ)-REACTION FOR ANALYTICAL PURPOSES. Sacha, J. (Fyzikalny Ustav SAV, Bratislava). Radioisotopy; 15: No. 6, 877-894(1974). (In Czech).

From conference on instrumental activation analysis; Marianske Lazne, Czech. (3 Jun 1974).

Results obtained with a device requiring no complicated and expensive neutron source are described. The measurements were realized on Cd and B. The measurement precision was checked in boron content determinations in lunar rock samples from the LUNA 20 space flight. (auth)

28966 SIMULTANEOUS DETERMINATION OF BARIUM, PHOSPHORUS, AND OXYGEN IN OIL ADDITIVES BY NEUTRON ACTIVATION ANALYSIS. Kliment, V.; Galan, P.; Scasnar, V.; Turzo, I.; Vandlik, T. (Fyzikalny Ustav SAV, Bratislava). Radioisotopy; 15: No. 4, 587-598(1974). (In Czech).

From conference on instrumental activation analysis; Marianske Lazne, Czech. (3 Jun 1974).

A method for simultaneous determination of barium, phosphorus and oxygen in oil additives was developed. A neutron generator with a yield up to 5×10^9 n/sec was used for the activation. The gamma spectrum of samples and standards was measured by two 100 × 100 NaI(Tl) scintillation detectors and was registered by a multichannel analyzer ND 4420 and by pulse counter. The following nuclear reactions were used for the determinations: $^{137}Ba(n,n')^{137m}Ba$, $^{138}Ba(n,2n)^{137m}Ba$, $^{31}P(n,\alpha)^{28}Al$ and $^{16}O(n,p)^{16}N$. The reproducibility of determination and the mutual influence of the determined elements were investigated. (auth)

28967 DETERMINATION OF SOME ELEMENTS IN LUNAR SAMPLE FROM LUNA 20 BY 14-MeV NEUTRON ACTIVATION ANALYSIS. Scasnar, V.; Kliment, V.; Vandlik, T.; Vano, M. (Fyzikalny Ustav SAV, Bratislava). Radioisotopy; 15: No. 4, 599-605(1974). (In Czech).

The abundances of oxygen, silicon and aluminum in lunar sample from LUNA 20 were determined by activation analysis with 14-MeV neutrons. In the sample 40.5 ± 1% of oxygen, 21.5 ± 0.7% of silicon, and 12.9 ± 0.7% of aluminum was found. (auth)

28968 ACTIVATION ANALYSIS OF SEMICONDUCTOR TECHNOLOGY MATERIALS. Kotas, J. (TESLA-Vyzkumny Ustav pro Sdelovaci Techniku, Prague); Obrusnik, I.; Simkova, M. Radioisotopy; 16: No. 1, 105-113(1975). (In Czech).

From conference on instrumental activational analysis; Marianske Lazne, Czech. (3 Jun 1974).

Activation analysis as one of the most sensitive methods of elemental analysis finds its use in semiconductor engineering not only for the determination of impurities and of the concentration distribution of doping admixtures but also for the analysis of materials used in the course of technological operations. This contribution deals with activation analysis of impurities in graphite used as base in chemical cleaning of single-crystal surfaces. Seven to twenty elements, in total 30 elements, were determined in four types of graphite. The measurement and results evaluation were performed on the gamma-spectrometric system Plurimat 20, a part of which is a small computer Multi 8 (24 channels). (auth)

28969 SIMULTANEOUS DETERMINATION OF 35 ELEMENTS IN RHODIUM SAMPLES BY NON-DESTRUCTIVE ACTIVATION ANALYSIS WITH 10 MeV PROTONS. Debrun, J. L.; Barrandon, J. N.; Benaben, P.; Rouxel, C. (CNRS, Orleans, France). Anal. Chem.; 47: No. 4, 637-642(Apr 1975).

The performances of activation analysis with 10-MeV protons from a cyclotron were tested in the case of Industrial rhodium samples. γ-Ray spectrometry with a Ge-Li detector was performed directly on the activated samples, after irradiation. Ti, Zn, Cd, Sn, and Sb were present at the part-per-mission level; the concentration of Ca, Cr, Fe, Cu, Br, and Ru ranged from ~10 ppM to ~80 ppM, while Ir and Pt were present at concentrations of several hundreds of parts per million. Upper limits of concentration were calculated for 22 other undetected elements; most of these limits range from several tenths of ppM to several ppM. (auth)

28970 SUBSTOICHIOMETRIC NEUTRON ACTIVATION DETERMINATION OF SODIUM: EXTRACTION OF SODIUM DICYCLOHEXYL-18-CROWN-6 TETRAPHENYLBORATE. Mitchell, J. W. (Bell Labs., Murray Hill, NJ); Shanks, D. L. Anal. Chem.; 47: No. 4, 642-646(Apr 1975).

A high accuracy method for the determination of traces of sodium by neutron activation was developed by selectively extracting sodium into chloroform as the dicyclohexyl-18-crown-6 ion-association complex with tetraphenylborate. Procedures for the substoichiometric extraction of sodium are described and results for the determination of sodium in a synthetic standard solution and in silicon dioxide samples are reported. These results, 0.240 ± 0.004 and 3.81 ± 0.18 μg/g, respectively, indicate an absolute error of 4.6% for the determination of sodium in the standard. (auth)

28971 DETERMINATION OF OXYGEN-18 IN WATER CONTAINED IN BIOLOGICAL SAMPLES BY CHARGED PARTICLE ACTIVATION. Wood, R. A.; Nagy, K. A.; MacDonald, N. S.; Wakakuwa, S. T.; Beckman, R. J.; Kaaz, H. (Univ. of California, Los Angeles). Contract AT(04-1)-gen-12. Anal. Chem.; 47: No. 4, 646-650 (Apr 1975).

A comparator activation method is described for the determination of oxygen-18 in water, using the nuclear reaction $^{18}O(p,n)\ ^{18}F$ ($T_{\frac{1}{2}}$, 110 min). A measure of the 0.511-MeV annihilation radiation from ^{18}F yields a measure of the ^{18}O. The

method is simple, requiring no chemical processing of the water other than distillation. The only competing reactions in the distilled $H_2{}^{18}O$ are the $^{18}O(p,\alpha)^{15}N$ and $^{13}C(p,n)^{13}N(T_{\frac{1}{2}}, 10\ min)$. These interferences are eliminated by storing the samples for 2 hr before counting. This method of ^{18}O analysis in the $He^{18}O$ yields precise results and is comparable in accuracy to mass spectrometry. Water samples as small as 1.5 μl can be analyzed for ^{18}O content using this activation technique. The primary advantage of this method of ^{18}O analysis in water over mass analysis and other activation techniques is the simplicity of sample preparation and radioassay, permitting the use of large numbers of samples in ^{18}O tracer studies. (auth)

28972 QUANTITATIVE MULTIELEMENT ANALYSIS USING HIGH ENERGY PARTICLE BOMBARDMENT. Clark, P. J.; Neal, G. F.; Allen, R. O. (Univ. of Virginia, Charlottesville). Anal. Chem.; 47: No. 4, 650-658(Apr 1975).

Charged particles ranging in energy from 0.8 to 4.0 MeV are used to induce resonant nuclear reactions, Coulomb excitation (γ-rays), and X-ray emission in both thick and thin targets. Quantitative analysis is possible for elements from Li to Pb in complex environmental samples, although the matrix can severely reduce the sensitivity. It is necessary to use a comparator technique for the γ-rays while for x-rays an internal standard can be used. A USGS standard rock is analyzed for a total of 28 elements. Water samples can be analyzed either by nebulizing the sample doped with Cs or Y onto a thin Formvar film or by extracting the sample (with or without an internal standard) onto ion exchange resin which is pressed into a pellet. (auth)

28973 NEUTRON CAPTURE GAMMA RAY ANALYSIS OF COPPER ORE USING CALIFORNIUM-252. Akalin, O. Salt Lake City; Univ. of Utah (1974). 109p. University Microfilms Order No. 75-6998.

Thesis (Ph. D.).

The feasibility of utilizing neutron capture gamma ray analysis (NCGA) or equivalently prompt neutron activation analysis for on-line analysis and process control of copper ore streams was studied. In the feed-forward control process of the milling of copper ore knowledge of the concentration of Cu(0.5 to 2%), Fe(4 to 6%), Al(3 to 7%), and Si(25 to 40%) in the ore is desirable. NCGA experiments have been conducted using known copper ore compositions for various counting times, neutron source configurations (3 encapsulated sources each at 2 mg of Cf-252), sample positions, moderation, shielding and Ge(Li) detector locations. The following detection limits were determined for the 80% confidence level; 0.32% for Cu, 1.56% for Fe, 3.6% for Al and 4.8% for Si for 100 minutes counting time interval. For shorter time intervals (40 minutes) the detection limit for aluminum was critical (3.86% concentration), while the other limits were well below the expected concentration in copper ore. Two significant problems associated with the industrial application of neutron capture gamma ray analysis for on-line process control were studied: (1) determining the optimum counting time interval consistent with accuracy requirements and (2) accounting for variations in ore moisture content. Results of the counting time experiments show that small counting time intervals increase the statistical uncertainty in the measured value. However, counting time intervals of 40 minutes or longer are acceptable for copper ore analysis within the allowable statistical error. The correction for the effects of moisture variation were based upon the incremental increase in the neutron flux resulting from improved neutron moderation. The correction relationship is linear with a slope of 3.36×10^{-3} (n/cm^2-sec/% moisture). The feasibility of neutron capture gamma ray analysis for on-line analysis and process control of copper ore for milling operations appears promising. (Diss. Abstr. Int., B)

28974 NEUTRON ACTIVATION ANALYSIS OF RARE EARTH ELEMENTS IN SEA SEDIMENTS. Ashikawa, I.; Umaya, S.; Shimamura, T. (Waseda Univ., Tokyo (Japan). School of Science and Engineering). Uchusen Kenkyu; 18: No. 3, 241-254(Jan 1974). (In Japanese).

Neutron activation analysis of sea sediments was made to detect ^{146}Sm from the deep sea sediments, and calculation of rare earth elements content in them was attempted. Both of JG-1 and JB-1, which were offered by the geological survey bureau as standard samples, were irradiated at the same time in an atomic pile and their contents were calculated by gamma spectra. These results were compared with chondrite. Contents of Nd and Br did not show any remarkable peak in both of JG-1 and JB-1, but there was much locality in La content of JG-1. As a characteristic of comparison with chondrite, the absolute value of content of rare earth elements showed extremely large values. This was thought to be that the samples were not direct inflows from the land, but rare earth elements out of each element dissolved in sea water were sedimented selectively by hydroxides. Fe and Th were contained in almost the same amount and sedimentation of Ce was large in STN-12-2 as compared with other rare earth elements. (JA)

28975 DETERMINATION OF ZINC CONTENTS IN THE SPERM OF MEN SUFFERING FROM ALCOHOLIC DISEASE. Apostolov, D.; Apostolova, M.; Protich, M. pp vp of Second National Conference of the Young Physicists. Sofia; Komitet za Mirno Izpolzuvane na Atomnata Energiya (1974). (In Bulgarian).

From second national conference of the young physicists; Sofia, Bulgaria (10 Apr 1974).

The contents of Zn in the sperm of men suffering from alcholic disease and of healthy men were studied by means of neutron-activation analysis. From every sample of sperm 1 ml was dried at 70°C for 48 hours. A Zn standard sample was also prepared. The sperm and the Zn sample were irradiated for 18 hours by a flux of 10^{13} neutrons/cm^{2}s. After a week the activity was measured using the γ-line 1,332 MeV of ^{60}Co. A 4000 canals amplitude analyzer was used. The data was treated by Covel's method. It is established that men, suffering from alcoholism, have two times more Zn in their sperm than healthy men. (INIS)

28976 NEUTRON ACTIVATION ANALYSIS OF TRACE ELEMENTS IN QUARTZ SANDS: ITS POSSIBILITIES IN THE ASSESSMENT OF PROVENANCE. Herrera, R.; Heurtebise, M. (Instituto Venezolano de Investigaciones Cientifices, Caracas). Chem. Geol.; 14: No. 1, 81-93(Oct 1974).

A study was made of the possibility of classifying quartz sands by means of the relative gamma-peak ratios of long half-life radioisotopes formed by adequate neutron activation. Sand samples of particle sizes from 105 to 250 μm were etched with HF in order to eliminate the outer layer of each grain so as to reach the unaltered core. An acid etching resulting in a weight loss of at least 20% was found to remove the more altered outer layers sufficiently. Then, after neutron irradiation and appropriate decay times, the treated samples were counted by means of a Ge(Li) detector. Activity ratios for ^{46}Sc, ^{59}Fe, ^{182}Ta, ^{152}Eu, ^{60}Co, ^{124}Sb and ^{95}Zr were computed relative to ^{181}Hf. A constant value of 25 (w/w) for the Zr/Hf ratio was found. The samples were then classified according to the observed activity ratios by graphical interpretation of data as well as by statistical analysis of Hotelling's T^2 and discriminant function. The method here described, being independent of neutron flux factors and not requiring standards, can be applied to large-scale studies. It was successfully applied to differentiate quartz sands in Venezuela. (NL)

28977 IRIDIUM IN SOME CALCIC AND CALC-ALKALIC BATHOLITHIC ROCKS OF THE WESTERN UNITED STATES. Greenland, L. P.; Gottfried, D.; Tilling, R. I. (Geological Survey, Washington, DC). Chem. Geol.; 14: No. 1, 117-122(Oct 1974).

Neutron-activation determinations of Ir in rocks of the Southern California and Boulder (Montana) batholiths show that the Ir content is low and variable in both batholiths, extending over 1 to 2 orders of magnitude and having a combined median of 0.006 ppB Ir. The data suggest that the calc-alkalic Boulder batholith (0.002-0.5 ppB Ir, median 0.007) may be slightly enriched in Ir relative to the calcic Southern California batholith (< 0.001-0.12 ppB Ir, median 0.005). No conspicuous relationship between Ir content and differentiation parameters is evident; however, the Boulder batholith rocks do show a slight tendency to concentrate Ir in the more mafic rocks. Results in conjunction with previous analyses of mafic rocks lead to a crustalabundance estimate of 0.03 ppB Ir. (NL)

28978 GALLIUM IN ROCKS AND MINERALS OF THE SKAERGAARD INTRUSION. Vincent, E. A.; Nightingale, G. (Oxford Univ.). Chem. Geol.; 14: No. 1, 63-73(Oct 1974).

Gallium was determined by radiochemical neutron activation analysis in a suite of 26 rocks from Skaergaard intrusion and in the separated cumulus minerals of two of them. The initial magma, as represented by the chilled marginal gabbro and other Border Group rocks, contained about 18-20 ppM Ga. The gallium content of rocks of average mineralogical composition increases somewhat towards the top of the Layered Series and in the late differentiates, reaching about 40 ppM; leucocratic (felspathic) bands carry more, and ferromagnesian silicate-rich bands less gallium than the average rocks at the same horizon in the sequence. While plagioclase accounts for the major proportion of the gallium found in the rocks, the highest concentrations of the element (up to 110 ppM) are found in titaniferous magnetite. The one ilmenite analyzed in contrast contains only 1 ppM Ga. The element appears to be entirely incorporated into the structures of the cumulus mineral phases, Ga^{3+} readily substituting for Fe^{3+} in tetrahedral cation sites in magnetite and markedly less readily for Al^{3+} in tetrahedral sites in plagioclase. (NL)

28979 DETERMINATION OF MERCURY IN WATER SAMPLES FROM THE ENVIRONMENT BY NEUTRON ACTIVATION ANALYSIS. van der Sloot, H. A.; Das, H. A. (Stichting Reactor Centrum Nederland, Petten). Anal. Chim. Acta; 73: No. 2, 235-244(Dec 1974).

A sensitive method for the determination of mercury in sea and surface waters is presented. A distinction is made between inorganic, organic, and particulate mercury. In the determination of inorganic mercury, the element is isolated by reduction and volatilization, followed by absorption on a charcoal column. The total mercury content of the water with and without suspended solids is determined by absorption from the solution onto a column of charcoal. In all cases, the mercury on the absorber is determined by thermal neutron activation analysis. The limit of detection is 1 ng l^{-1}. (NL)

28980 NON-DESTRUCTIVE DETERMINATION OF SILVER IN LEAD BY NEUTRON ACTIVATION WITH A ^{227}Ac-Be ISOTOPIC NEUTRON SOURCE. Alaerts, L.; van Schuerbeek, J.; op de Beeck, J. P.; Hoste, J. (Rijksuniversiteit, Ghent). Anal. Chim. Acta; 73: No. 2, 225-234(Dec 1974).

A method was developed for the determination of silver in lead by instrumental neutron activation analysis with the aid of a ^{227}Ac-Be isotopic neutron source. The samples are irradiated for 60 s, allowed to decay for 10 s, and counted for 60 s. ^{110}Ag can be measured free of interferences provided that copper and antimony do not occur in concentrations higher than about 1000 ppM. A calibration curve was established for silver concentrations between 0 and 4000 ppM by means of standards prepared by melting together high-purity silver and lead under a hydrogen atmosphere. For 17.5-g lead samples, containing between 1000 and 2500 ppM of silver, a mean relative precision of 0.8% was obtained after a 10-min analysis. (NL)

28981 USE OF THE RADIOISOTOPIC CONTROL METHOD IN THE FLOTATION PROCESS. Rozhavsikki, G. S.; Kushnikova, V. G.; Meshchaninova, V. I.; Ovechnikova, K. I.; Glazunov, L. A. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 11-15(1974). (In Russian).

The use of neutron activation analysis to control the various stages in the flotation process was studied using a sulfide copper-molybdenum ore. Representative samples of both tailings and concentrates were taken at various stages and exposed to a neutron flux of 1.2×10^{13} n/cm^{2}sec. The γ radiation of the induced radioisotopes were measured with scintillation counters. The distribution of Cu between the tailings and concentrates was easily determined from these measurements. (JSR)

Chemical and Spectral Procedures

Refer also to abstracts 29201, 29751, and 31772.

28982 (BARC-740) MODIFIED METHOD FOR DETERMINATION OF RARE EARTHS IN HIGH-PURITY GADOLINIUM OXIDE USING STALLWOOD JET. Grampurohit, S. V.; Kaimal, V. N. P. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

A spectrographic method is described for estimating trace rare-earth impurities in high-purity gadolinium oxide. The sample is mixed with graphite and excited in a dc arc using Stallwood Jet. The spectrum is recorded in the second order of 3.4-meter Jarrell Ash grating spectrograph with a reciprocal linear dispersion of 1.2 Å/mm. The precision of the method is ±11%. The detection limit for terbium is 0.025% and for the remaining elements is 0.01%. (auth)

28983 (CONF-741030-9) SIMPLIFIED SEPARATION METHOD FOR SIMULTANEOUS U AND Pu ISOTOPIC ANALYSIS WITH A TWO-STAGE MASS SPECTROMETER. Carter, J. A.; Walker, R. L.; Eby, R. E.; Pritchard, C. A. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 8p. Dep. NTIS $4.00.

From symposium on thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974).

Experimental results indicate that reliable isotopic analysis of plutonium and uranium in spent reactor fuels can be done with minimal chemistry and sample handling on very small samples by the use of anion resins for separation and direct loading of resin bead on a mass spectrometer filament. An aliquot of a typical dissolver solution containing approximately 10 μg U, 65 ng Pu, and 10 μCi of fission products would be sufficient sample for making the determinations. The precision of an analysis expressed as relative standard deviation is <1% on major isotopes. The assay of ^{238}Pu, if in the range of 0.1 at. %, can be measured by the simplified resin bead technique. Ways of improving the ^{238}Pu assay are demonstrated. The main advantages of this simplified method are: (1) Decreased analytical laboratory separation costs. For example, field inspectors could adapt the separations technique and mail 3 or 4 beads to the laboratory for mass analysis; (2) reduction of radiation hazards in handling small samples in an unshielded laboratory; (3) reduction of sample transportation costs in the Safeguards programs. Decontamination factors for fission products are high; Am, Cm and Cf are completely separated; and (4) provision of a second technique for obtaining reliable ^{238}Pu values. The lessening of radiation hazard in shipping and the resulting saving in transportation costs probably are the most important advantages. This aspect of the method would be very important in Safeguards analyses whether on a national or international basis. (auth)

28984 (MLM-1602) DETERMINATION OF As(III) BY CONTROLLED-POTENTIAL COULOMETRY. Bohl, D. R.; Koehler, F. A.; Sellers, D. E. (Mound Lab., Miamisburg, Ohio (USA)). 20 May 1969. Contract AT(33-1)-Gen-53. 11p. Dep. NTIS $4.00.

A controlled-potential coulometric procedure was extended for use in the determination of microgram quantities of arsenic. Improved sensitivity and accuracy were obtained by using a small titration cell in conjunction with an electronic solid-state, controlled-potential coulometer (Model 810, Monsanto Research Corporation). Results for twenty-seven As(III) determinations at the 120 to 360 μg level had an average error of +0.19% and a relative standard deviation of ±0.22%. The controlled-potential coulometric procedure for the determination of As(III) compares favorably to constant-current coulometric procedures, but the titration end-point using the controlled-potential method is easily determined without the requirement of special apparatus. (auth)

28985 (NIM-1679) DETECTION OF NOBLE-METAL IMPURITIES IN REFINED NOBLE-METAL SOLUTIONS BY THIN-LAYER CHROMATOGRAPHY. Krueger, M. M.; Pohlandt, C. (National Inst. for Metallurgy, Johannesburg (South Africa)). 25 Nov 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

Rapid semiquantitative thin-layer chromatographic techniques were developed for the determination of noble-metal impurities during plant-scale purification of individual noble metals. Silica gel G was used as the adsorbent, and, where reversed-phase elution chromatography was employed, silica gel containing a binder was used. Impurities in rhodium, iridium, and ruthenium solutions were separated by the use of 5 N hydrochloric acid as the stationary phase and a mixture of tri-n-butyl phosphate and toluene as the eluant. Impurities in gold and palladium were separated by the use of tri-n-butyl phosphate and iso-octyl thioglycolate, respectively, as the stationary phase, and hydrochloric acid solutions as the eluant. After separation, the impurities were located by spraying with rubeanic acid solution, and were determined by visual comparison with standard plates. The determination of impurities in platinum solutions failed, owing to the lack of a selective extractant for these solutions. (auth)

28986 (ZFK-256) HOT SCALE TESTING OF LABORATORY METHODS AND EQUIPMENT FOR DESTRUCTIVE BURNUP DETERMINATION AND A CONCEPTION OF HIGHER ACCURACY METHODS. Hermann, A.; Baraniak, L.; Huebener, S.; Katzwinkel, L.; Legler, R. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1973. 142p. (In German). Dep. NTIS (US Sales Only) $10.25.

The destructive burnup determination of two type EK-10 fuel elements (86.5% UO_2; 13.1% Mg; 10% ^{235}U; Al-jacket) of the Rossendorf Research Reactor WWR-S is described. A cutting device was installed in a hot cell in order to get the fuel element pieces (1 cm in length) for testing and the fuel samples were cut out at definite places with an uncertainty of < ±1 mm. An apparatus for dissolving the samples was developed and placed in a hot cell. The fuel matrix was dissolved in 12N HNO_3. The Al-jacket and a black residue remained undissolved but didn't contain activity to be considered in the following determinations. The burnup values were determined by measuring the fission product to uranium ratio. ^{137}Cs was separated from strong acid solution by means of the inorganic ion exchanger ammonium molybdatophosphate (AMP) and the absolute activity was measured after dissolving the column in sodium hydroxide solution. ^{90}Sr was also isolated on an AMP column. After washing the column with 10 ml 0.1 M NH_4NO_3 the ^{90}Sr was eluted with 40 ml 3 M NH_4NO_3. Uranium was determined coulometrically and spectrophotometrically with Arsenazo III. Burnup values from the amount of ^{137}Cs and ^{90}Sr were estimated on five samples of fuel rod No. 1 and four samples of fuel rod No. 2 with an accuracy of ±3.5% and ±7% respectively. In the burnup maximum values of 17.0% (rod No. 1) and 18.0% fifa (rod No. 2) were reached. The burnup distribution over the length of the fuel elements is in good agreement with the non-destructive γ-scan. In the future stable fission products are to be determined in order to rise the accuracy of burnup values. This problem is dealt with in a literature survey. A summary of literature and

first experimental results are given for the separation of U from fission products as the initial step for mass spectrometry. (auth)

28987 COMMENT ON: "OXYGEN ANALYSIS OF SODIUM BY EQUILIBRATION WITH VANADIUM: AN ASSESSMENT". Grundy, B. R.; Durigon, D. D. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). J. Nucl. Mater.; 55: No. 1, 111-112(Jan 1975).

Hooper and Trevillion recently made an assessment of the vanadium wire equilibration method for analysis of oxygen in sodium, in which they claim to have shown theoretically that the method is only applicable up to 1.9 ppM oxygen in sodium at 750°C, rather than about 15 ppM claimed by Smith. While undoubtedly there are discrepancies between the data of Smith, Fromm and Kirchein, and other cited sources, it is a matter of experience that, based on Smith's data the vanadium equilibration method is applicable up to about 15 ppM oxygen in sodium. (auth)

28988 ANALIZ MOLIBDENA I EGO SPLAVOV. (Analysis of Molybdenum and its Alloys). Pyatiletova, N. M.; Yaroshenko, A. D.; Novikova, I. S.; Orlov, V. V. Moscow; Metallurgiya (1974). 128p.

Methods for the determination of impurities of Fe, Al, Mn, Si, P, and B in metallic Mo and of Zr, Hf, Ti, Ta, Re, W, Nb, B, Cr, V, Al, Fe, rare earth elements, Y, Mg, Be, Co, Ni, Mn, Cu, Si, P, Pb, Sb, As, C, and S in Mo alloys are examined. The majority of the chemical methods are based on the use of new organic reagents. Special attention is given to rapid methods of analysis. Spectrophotometric and photometric methods are primarily discussed, but gravimetric and titrimetric methods are also considered. The determination of hydrogen and oxygen by methods of vacuum fusion and vacuum annealing is also examined. (tr-auth)

28989 DETERMINATION OF PALLADIUM IN TITANIUM AND MOLYBDENUM BY THE ATOMIC-ABSORPTION METHOD. Begak, O. Yu.; Nikolaev, G. I.; Pokrovskaya, K. A. Ind. Lab. (USSR) (Engl. Transl.); 40: No. 8, 1152(Aug 1974).

Translated from Zavod. Lab.; 40: No. 8, 963-964(Aug 1974).

Absorption of palladium was investigated as a function of the width of the spectral slit of the monochromator, the magnitude of the discharge current of the lamp with the hollow cathode, and the distance between the surface of the burner and the optical axis of the radiation beam from the spectral lamp. Optimum values are: $\Delta = 1.5$ Å, I = 12.5 mA, and H = 8.0-9.0 mm. The sensitivity in determining Pd is 0.3 μg/ml. (LK)

28990 USE OF FERROCENE FOR THE PHOTOMETRIC DETERMINATION OF MOLYBDENUM IN NIOBIUM-BASED STEELS. Solomatin, V. T.; Lapshina, L. A.; Artemova, T. N.; Yakovlev, P. Ya. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 8, 1119-1120 (Aug 1974).

Translated from Zavod. Lab.; 40: No. 8, 937-938(Aug 1974).

Ferrocene reduced molybdenum(VI) in hydrochloric acid-acetic acid solution and was oxidized to give the blue color of the ferricene cation. Interference from thiocyanate complexes of niobium is avoided by adding a masking agent. Sensitivity of the method is 0.2 μg/ml. (LK)

28991 DETERMINATION BY LUMINESCENCE OF TERBIUM AND DYSPROSIUM WITH IMINODIACETIC ACID AND TAIRON. Tishchenko, M. A.; Gerasimenko, G. I.; Poluektov, N. S. (Odessa Labs. of the Inst. of General and Inorganic Chemistry). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 8, 1117(Aug 1974).

Translated from Zavod. Lab.; 40: No. 8, 935-936(Aug 1974).

To carry out an analysis by luminescence, 1 ml of a 1×10^{-3} m solution of rare-earth element chlorides was treated with 1 ml of 1×10^{-3} m solutions of tairon and iminodiacetic acid, 1 ml of caustic soda, and 0.5 ml of $NaClO_4$, and made up to 10 ml with water. Relative values of the intensity of luminescence were measured at 546 nm (Tb) and 577 nm (Dy) and compared with the intensity of luminescence for standard solutions. Sensitivity of the method was 2.3×10^{-11} m for Tb and 5×10^{-9} m for Dy. (LK)

28992 USE OF TRIBUTYL PHOSPHATE FOR THE EXTRACTIVE GRAVIMETRIC DETERMINATION OF TANTALUM. Goryanskaya, G. P.; Merisov, Yu. I. (State Scientific-Research and Planning Inst. of the Rare-Metals Industry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 8, 1114-1115(Aug 1974).

Translated from Zavod. Lab.; 40: No. 8, 934-935(Aug 1974).

A method was developed for the extractive gravimetric determination of tantalum in technical grade niobium hydroxide and in tantalum concentrates, in which the Ta : Nb ratio can vary upwards from 1 : 50, with no upper limit. The tantalum is separated from niobium and other elements by extraction with 100% TBP from aqueous solutions 1M in HF and 1M in HNO_3. The method was used to determine tantalum in coded samples, which have already been analyzed by other methods. The relative standard deviation did not exceed 0.03. (LK)

28993 DETERMINATION OF MOLYBDENUM IN Mo-W ALLOYS BY TITRATION WITH FERROCENE. Yakovlev, P. Ya.; Solomatin, V. T.; Bakalova, L. M. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 8, 1088-1089(Aug 1974).

Translated from Zavod. Lab.; 40: No. 8, 915-916(Aug 1974).

A rapid method was developed for the determination of molybdenum in Mo-W alloys. Molybdenum oxinate reacts with ferrocene in 6 to 8 N hydrochloric acid in acetic acid, but tungsten oxinate does not. Molybdenum can be determined by potentiometric titration without interference from tungsten. (LK)

28994 VERSIONS OF ENERGY DISPERSIVE X-RAY EMISSION ANALYSIS. I. Survey and Foundations. Thuemmel, H. W. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 11: No. 1, 1-12(Jan (1975). (In German).

The methodical variations used in energy dispersive x-ray emission analysis are reviewed. The principles of this type of analysis are discussed in detail with a consideration of errors from pulse height analyzers, characteristic x-ray spectra, scattering and bremsstrahlung radiation from the sample, perturbing effects connected with absorption processes in the detector, statistical processing of the data, errors resulting from the amplifier electronics, detector sensitivity function, and other interfering effects. (JSR)

28995 A METHOD OF MIXED CHROMATOGRAPHY FOR THE ISOTOPIC ANALYSIS OF DEUTERIUM OR HYDROGEN AND THE DETERMINATION OF COMMON IMPURITIES IN THESE GASES. Tistchenko, S.; Botter, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Analyses et d'Etudes en Chimie Nucleaire et Isotopique). Analusis; 2: No. 9, 664-671(1973). (In French).

The isotopic analysis of hydrogen or deuterium and the determination of traces of oxygen and nitrogen can be carried out either by frontal analysis or by an original method using a chromatographic separation, referred to as mixed chromatography. The latter technique is intermediate between an elution and a frontal analysis: as in an elution a deuterium or hydrogen sample is injected with a reference current of deuterium (or hydrogen) onto a column of 5 A molecular sieves at room temperature; hydrogen (or deuterium), oxygen, and nitrogen appear successively in the form of stages or crenellations, the height of which characterizes the concentration of the various components as in frontal analysis. The detection limits of mixed chromatography are respectively 6 and 1.5 ppm for deuterium and oxygen and nitrogen in hydrogen, 10 and 2 ppm for hydrogen and oxygen or nitrogen in deuterium. This method is differential, and its accuracy depends on the composition of the reference gas. An analysis lasts 15 minutes on a simple and inexpensive apparatus. 140 cm^3 NTP of the gas to be analyzed and 1 liter of reference gas (standard hydrogen or deuterium) are used. The methods described are also applicable to the chemical analysis of other gas mixtures. They can be used for example in any manufacture or use of deuterium or hydrogen. (FR)

28996 ANALYTICAL METHODS FOR CHARACTERIZATION OF FLY ASH. Cavin, D. C. (Shell Development Co., Houston, TX); Klemm, W. A.; Burnet, G. Proc. Iowa Acad. Sci.; 81: 130-134(1974).

A typical power plant fly ash was characterized according to its composition and physical properties as a basis for research on iron and aluminum recovery from the ash. The methods used are standard and require facilities and instruments available in many laboratories today. The procedures include photomicroscopic observation, size separation, magnetic separation, X-ray diffraction, thermal gravimetric analysis, differential thermal analysis, electron microprobe analysis and emission spectroscopy. The results will be useful in determining in what ways and under what conditions a given fly ash may be treated to recover the metals present in a usable form. Preliminary work has been done on a sulfuric acid leaching process and on a lime sintering process patterned after exploratory studies from Poland in 1973. (auth)

28997 BIAMPEROMETRIC END-POINT DETERMINATION IN THE TITRATION OF FLUORIDE WITH THORIUM NITRATE. Gaal, F. F.; Jovanovic, L. S.; Canic, V. D. (Novi Sad Univ. (Yugoslavia). Inst. of Chemistry). Z. Anal. Chem.; 272: No. 2, 117-120(Nov 1974).

2 figs.; 2 tabs.; 4 refs.

The possibilities of the biamperometric end-point detection in the titration of fluoride by means of thorium nitrate were investigated applying different pairs of identical indicator electrodes. In unbuffered solutions using aluminium, bismuth, and tin pairs of polarized indicator electrodes, amounts of 6.2 to 12.5 mg of potassium fluoride were determined with an average deviation of less than 0.3%. In solutions containing buffer pH 3.0, polarized

or nonpolarized pairs of aluminium electrodes can be applied only. Amounts of 5.2 to 10.5 mg of potassium fluoride and 3.0 mg of sodium silicofluoride were determined with an average deviation of less than 0.8%. In all determinations the content of ethanol was 75% at the end-point of the titration. The results obtained were in good agreement with those of potentiometric, photometric and amperometric titrations. (auth)

28998 DETERMINATION OF BORON BY ISOTOPE DILUTION. Landry, J. C.; Buchs, A.; Monnier, D.; Landry, M. F. (Univ., Geneva). Mitt. Geb. Lebensmittelunters. Hyg.; 65: No. 1, 65-81(1974). (In French).

The B is converted into $Na_2B_4O_7$, which is analyzed by thermal-ionization m.s. after addition of ^{10}B tracer. The species observed is $Na_2BO_2^+$ (m/e 88, 89 et seq.), and the ratio of ^{10}B to ^{11}B is measured and used to calculate the B content of the sample with use of the known isotopic abundances of the tracer and of natural B. Glycerol is added to the $Na_2B_4O_7$ to counteract the suppressive effect of the NaOH present on the formation of $Na_2BO_2^+$. Rhenium is the most suitable material for the spectrometer filament (although a tungsten filament can be used), and the absolute sensitivity corresponds to 8.7 ng of tracer B applied to the filament. Relative lower limits of sensitivity at various levels of the tracer have been established. There is interference only from ^{88}Sr, from which the B can be separated by distillation as trimethyl borate. Applications of the technique to the determination of B in steel (nominal B content 25 ppm) and in glycerol are described. (Anal. Abstr.)

28999 DETERMINATION OF LITHIUM-7, MOLECULAR TRITIUM, AND HELIUM-3 IN LITHIUM TRITIDE BY PULSED NUCLEAR MAGNETIC RESONANCE SPECTROMETRY. Attalla, A.; Bowman, R. C. Jr. (Monsanto Research Corp., Miamisburg, OH). Contract AT(33-1)-gen-53. Anal. Chem.; 47: No. 4, 728-730 (Apr 1975).

The sources of error inherent in pulsed NMR are discussed. The precision and accuracy reported are ±2% and ±3%. (auth)

29000 SINGLE-SWEEP POLAROGRAPHIC TECHNIQUES USEFUL IN MICROPOLLUTION STUDIES OF GROUND AND SURFACE WATERS. Whitnack, G. C. (Naval Weapons Center, China Lake, CA). Anal. Chem.; 47: No. 4, 618-621(Apr 1975).

Single-sweep polarography offers many advantages to the chemist who is faced with the control and analysis of water quality today. Some of these such as a technique that can characterize soluble species; a highly sensitive (parts-per-billion) method suitable for field operation, automation, and continuous monitoring; and direct analyses, with preconcentration or separation of the micropollutant from the water sample many times unnecessary, and matrix problems of interference minimized, are discussed. Single-sweep polarographic procedures have been developed in these laboratories that have proved useful in detecting and analyzing for a number of micropollutants of river water, well and spring water, tap water, sea water, and effluent waters from many sources. Potential methods of analysis are discussed for chromium (Cr^{III} and Cr^{VI}), arsenic (As^{III} and As^{V}) and iodine (I^- and IO_3^-) soluble ionic species. Some uranium, selenium, lead, cadmium, tellurium, thallium, manganese, copper, nickel, and zinc ionic species were also studied and techniques are presented for their analysis. Techniques for the single-sweep polarographic analysis of traces of explosives and plasticizers in water, such as nitroglycerine, 1,2-propylene glycol dinitrate, 2,4,6-trinitrotoluene (TNT), 1,3,5-trinitro-1,3-5-hexahydrotriazine (RDX), diethyl phthalate, and dibutyl sebacate are also presented and discussed. (auth)

29001 IODINE DETERMINATION IN BIOLOGICAL MATERIAL. Kinetic Measurement of the Catalytic Activity of Iodine. Lauber, K. (Univ., Bern). Anal. Chem.; 47: No. 4, 769-771(Apr 1975).

Dry alkaline incineration of organic matter is followed by kinetic assay of the catalytic activity of iodide in the Ce(IV)–As(III)-redox-reaction. The limit of detection is about 1 ng I/g organic matter. (auth)

29002 RAPID ANION-EXCHANGE METHOD OF SEPARATING MOLYBDENUM(VI) AND BORON(III) IN THE ANALYSIS OF MOLYBDENUM BORIDES. Khristova, R.; Dimitjrova, M.; Filcheva, E. Metalurgiya (Sofia); 28: No. 11-12, 26-28(1973). (In Bulgarian).

A rapid anion-exchange method of analyzing Mo borides of various compositions after conversion of the Mo and B into hexavalent and tervalent form, respectively, is proposed. Any one of five anion-exchange resins may be used, the choice depending on the particular circumstances (e.g., the weight and composition of the original specimen). The Mo may be determined by three different methods after separation, the most convenient being complexometric titration with potentiometric indication of the balance point. A typical experimental error is 1%. Examples of the analysis of several kinds of sample are presented. 7 references. (Metal Abstr.)

Radiometric and Radiochemical Procedures

Refer also to abstracts 29166, 29681, 29691, 29730, 30078, and 30079.

29003 RADIOACTIVE KRYPTONATES OF ORGANOSULFUR COMPOUNDS. VIII. Thermal, X-Ray, and Dekryptonation Study of N-[2-(5-Methoxy)Pyrimidinyl]-4-Isothiocyanatophenylsulfonamide. Uher, M.; Harangozo, M.; Tolgyessy, J.; Jesenak, V.; Kosik, M. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 20: No. 4-5, 289-294(28 Feb 1975).

The synthesis of radioactive kryptonate of N-[2-(5-methoxy)-pyrimidinyl]-4-isothiocyanatophenylsulfonamide by a diffusion technique and the thermal (DTA, TG, DTG), x-ray and dekryptonation thermal studies of this kryptonate are described. (auth)

29004 MANUFACTURE AND USE OF ^{14}C REFERENCE STANDARDS FOR QUENCH CORRECTION OF LSC MEASUREMENTS. Dermietzel, J.; Roesseler, M. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 10: No. 11-12, 396-400(1974). (In German).

The value of the random error to be expected with LSC measurement has been determined with discussion of the individual amounts yielding the total error. It is shown that relative measurement can be performed with an accuracy of $\leq \pm 1$ percent (3σ) when measuring conditions are fully comparable. It is shown on examples that efficiency determination with external standards to a certain degree has its limitations. In case of doubt an internal standard should be used for control purpose. (auth)

29005 ANALYSIS OF SODIUM SELENITE ^{75}Se SOLUTIONS. Kharlamov, V. T.; Shubnyakova, L. P.; Inkin, A. A.; Sysoeva, E. S. (Inst. of Biophysics, Moscow). Isotopenpraxis; 10: No. 11-12, 407-411(1974). (In Russian).

Paper chromatography and paper electrophoresis methods were used to determine the radiochemical composition of sodium selenite ^{75}Se solutions. A foreign radiochemical matter was found. The coulometric method was applied for the quantitative determination of sodium selenite after its separation by means of paper electrophoresis. (auth)

29006 ABSOLUTE MEASUREMENTS OF THE ACTIVITY OF AN I NUCLIDE IN A REFERENCE SOURCE. Aristov, E. A.; Bazhenov, V. A.; Gerasimov, Yu. S. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 7, 1070-1073(Jul 1974).

Translated from Izmer. Tekh.; 17: No. 7, 57-59(Jul 1974).

It has been shown that the ^{125}I nuclide activity at the source can be evaluated with an error smaller than 1% by means of the $4(2)\pi(e,x)$-(x,γ), $2\pi(e,x)$-$(x + x, x + \gamma)$-coincidence method with the extrapolation of $N_{\gamma,x}/N_c$ towards 1 and a corresponding selection of measuring conditions. In this method it is not necessary to know the nuclide decay-scheme parameters. (LK)

29007 THE DETERMINATION OF PARTS PER MILLION LEVELS OF THORIUM IN OPTICAL COMPONENTS BY X-RAY FLUORESCENCE. Keenan, J.A. (Materials Characterization Laboratory, Texas Instruments Incorporated, Dallas, Texas 75222). Appl. Spectrosc. 29: No. 1, 63-67 (Jan 1975).

A nondestructive technique for the determination of thorium in optical glass has been devised using tube–excited x–ray fluorescence with an energy–dispersive detector. Capability for full calibration and sample analysis has been incorporated into a computer–coupled system. Bulk thorium concentrations as low as 87 ppM have been detected with a coefficient of variation of 27.2% at 95% confidence using NBS–certified standards. At 466 ppM the coefficient of variation was 5.6% at the 95% confidence level. Qualitative determination of thorium in optical coatings has been demonstrated also. (auth)

29008 RAPID METHOD OF PROPORTIONING FOR ^{90}Sr IN LOW CONCENTRATIONS IN BIOLOGICAL SPECIMENS. Congiu, C.; Mascia, C.; Spano, F. (Univ. of Cagliari, Italy). G. Fis. Sanit. Prot. Radiaz.; 18: No. 4, 148-150(1974). (In Italian).

A method which allows proportionation of the mixture ^{90}Sr-^{90}Y in secular equilibrium in a short time, when it is present in a low concentration in biological specimens such as, for instance, bony tissue, has been set up. Its control and the eventual single determination of ^{90}Sr can be achieved through a paper chromatography, without using yttrium and carrier-free strontium, and without any chromatic detection through chemical means. (auth)

29009 SELECTIVE DETECTION OF FISSION PRODUCTS AFTER MECHANICAL COLLECTION ON A FILTER. Sandrik, S.; Melichar, Z. (EGU, Jaslovske Bohunice, Czech.). Radioisotopy; 16: No. 1, 37-62(1975). (In Czech).

A device for degassing of carrier, a filtration head, filters, and detectors are proposed in the part on solid fission products detection. A computer program "ISOTOP" was used to calculate activities of first, second, and third daughter of selected fission

decay chains, which are expected to be caught by a filter. A formula for time dependence of activity on a filter was derived. (auth)

29010 RADIOMETRIC SEPARATION OF URANIUM ORE MINERALS WITH ANALOG EVALUATION OF DETECTED PULSE RATE. Hejtman, J. (Czechoslovak Uranium Industry, Kamenna). Rudy (Prague); 21: No. 11, 363-367(Nov 1973). (In Czech).

An analog method is described for evaluating the detected pulse rate. Relations are derived for the probability of taking grains of uranium minerals for the enriched product in relation to the parameters of the uranium minerals, the analysis machine, and the technological regime. A program was written for the ODRA-1204 computer for computing the technological results of analysis. The comparison of computed data with the results of operation confirmed that the new method of computation was considerably more accurate. (Nucl. Sci. Abstr. Czech.)

29011 POSSIBILITY OF REDUCING THE EFFECT OF CHEMICAL COMPOSITION OF MATERIAL IN VOLUME WEIGHT DETERMINATIONS BY GAMMA BACKSCATTER METHODS. Novakova, O. (TESLA, Premysleni, Czech.); Sizak, V.; Smola, J.; Votava, P. Radioisotopy; 16: No. 1, 92-103(1975). (In Czech).

The possibility of eliminating the effect of chemical composition on the weight volume values measured with a gamma backscatter gauge is discussed. The different possibilities of arrangement of the detection unit for the dual-trace technique are reviewed. The magnitude of the error was investigated in experimental determinations of a volume weight Q = 1600 kg/m^3 for Z_{ef} for different arrangements both with the single-trace and dual-trace method. The results demonstrate that the dual-trace method reduced significantly the error due to chemical composition in volume weight determinations. (auth)

29012 RADIOACTIVE-TRACER DISPLACEMENT METHOD FOR THE DETERMINATION OF SMALL QUANTITIES OF NICKEL. German, R. A.; Hamilton, D. L.; Menon, M. P. (Savannah State Coll.). Anal. Chem.; 47: No. 4, 658-661(Apr 1975).

In this work, the metal chelate displacement reaction has been shown to have analytical application. The displacement reaction between nickel and zinc ethylenediaminetetraacetate was used to develop a radioactive tracer displacement method of analysis of traces of nickel. This method is based on the extraction of radioactive zinc displaced by nickel from the zinc chelate which is labeled with 245-d ^{65}Zn into a dithizone-carbon tetrachloride solution and the subsequent measurement of the activity of an aliquot of the extract. With this procedure, nickel can be measured in concentrations as low as 0.05 ppM and perhaps even lower, depending on the specific activity of the radioreagent used. The transition metals do interfere with the analysis, but the interferences of many may be removed by suitable masking agents. In the presence of significant amounts of interferers, nickel is first separated by the dimethyl glyoxime method and then determined by the procedure reported here. This method was tested by analyzing several NBS reference standards and was comparable in accuracy with other techniques. (auth)

29013 ELEMENTAL ANALYSIS BY USING ACCELERATOR. Morita, S.; Shiokawa, T.; Ishii, K. (Tohoku Univ., Sendai (Japan). Faculty of Science); Tawara, H. Genshiryoku Kogyo; 20: No. 6, 40-45(Jun 1974). (In Japanese).

Elemental analysis with high sensitivity was carried out in small amounts of samples, by using heavy electron beams accelerated by a Van de Graaff. The samples, which were set to the rotating target holder, were irradiated with a beam from a Van de Graaff accelerator. As the specific x rays were emitted from elements in the ionized samples, the elements and their amounts were determined by the x-ray spectrum. The confidence coefficient was 99.7%, the irradiation dose was 30 μC, and the measurement duration was about 1 hour. The detectability limit ranged from the precision of 10^{-11} to 10^{-8} g by element. Eleven elements were determined and assayed in 0.05 ml of tomato juice. Analysis of slice of human liver revealed that elemental components of the liver are different by patient. The analysis on human hair and annual layers of tree by this method demonstrates the history of disease in persons and change and accumulation of environmental contamination for long duration. (JA)

29014 MULTIELEMENT ANALYSIS OF AIRBORNE DUST BY ENERGY DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY. Mizohata, A.; Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai (Japan)). Radioisotopes (Tokyo); 23: No. 8, 443-449(Aug 1974). (In Japanese).

A method of matrix correction is presented, which is conveniently applied to energy dispersive x-ray fluorescence analysis of airborne dust collected on a membrane filter. In this method matrix correction for an element is made using an experimentally determined value of the corresponding effective total mass absorption coefficient μ. When samples to be analyzed are so many, it is quite troublesome and often impracticable to determine the value of μ for each sample. In the case that samples have similar matrix composition, it is possible that values of μ are determined for several samples selected from them and the averaged value is used to make matrix correction for all the samples. Detection limits of various elements obtained by the used analytical system were estimated. (auth)

29015 APPLICATION OF THICK-SOURCE ALPHA PARTICLE SPECTROMETRY TO THE DETECTION OF DISEQUILIBRIUM IN THE RADIOACTIVE DECAY SERIES OF URANIUM-238 IN ROCKS AND MINERALS. Killeen, P. G. London, Ont.; Univ. of Western Ontario (1971). 220p.

Thesis.

The natural radiation from rocks and minerals is primarily from the ^{238}U and ^{232}Th radioactive decay series. This is comprised of alpha particles of 23 different energies, along with beta and gamma radiation. Although the analysis of rocks for uranium content by gamma spectrometry is a rapid and efficient method it depends on the crucial assumption that the ^{238}U decay series is in radioactive equilibrium. A method of detecting the presence of disequilibrium in the ^{238}U decay series was developed. A silicon semiconductor detector and a 1024 channel pulse height analyzer were used to obtain over 250 alpha particle energy spectra of uraniferous rocks and minerals. "Infinitely thick" sources were used to avoid the problems involved in preparation of "infinitely thin" sources. The problem of generating theoretical energy distributions for infinitely thick sources was solved. Complete theoretical spectra were computed for comparison with experimentally obtained alpha particle energy spectra of rocks and minerals. The presence and extent of disequilibrium in the ^{238}U decay series in a rock is determined from the residual spectrum obtained by subtracting a fitted theoretical spectrum from the measured spectrum of a rock. (auth)

29016 LIQUID SCINTILLATION COUNTING. Volume 3. Proceedings of a Symposium Held in Brighton, England, September 3–6, 1973. Crook, M. A.; Johnson, P. (eds.). London; Heyden and Son Ltd. (1974). 316p. (CONF-7309133-P3). Sadtler Research Laboratories, Inc., Philadelphia. $27.50.

Twenty eight papers presented at the symposium are included. A separate abstract was prepared for one paper. The remaining 27 papers were previously abstracted for NSA and appeared as abstracts 31: 10575 through 10595 and 11329 through 11334. (MCG)

For an abstract of an individual paper see: 29017.

29017 ANALYTICAL BIOLUMINESCENCE ASSAYS USING THE LIQUID SCINTILLATION SPECTROMETER: A REVIEW. Stanley, P. E. (Univ. of Adelaide). pp 253-272 of Liquid Scintillation Counting. Vol. 3. Crook, M. A. (ed.). London; Heyden and Son Ltd. (1974).

From symposium on liquid scintillation counting; Brighton, UK (3 Sep 1973). See CONF-7309133-P3.

The light emission from bioluminescence reactions has been shown to have a wide range of analytical applications. While some of those discussed have to date been measured only in a photometer or even with the naked eye, the liquid scintillation spectrometer could, in most cases, have been used and with increased sensitivity. The areas in which advances can be expected are those for the assay of specific enzymes and substrates and their uses will no doubt expand rapidly when an instrument becomes available commercially which can automatically process samples. This will then make procedures useful not only in the research field but also in the clinical field of microbiochemistry, e.g., in testing for genetic enzyme deletions in amniocentesis samples, where currently routine tests are not available. Thus far more emphasis has been placed on ATP-based assays, but because of the extremely wide range of dehydrogenase enzymes it is likely that the NADH assay system will become more important in the assay of a wide range of compounds with a high degree of specificity and sensitivity, e.g., prostaglandins. (auth)

Separation Procedures

Refer also to abstracts 29035, 29127, 29197, and 29198.

29018 (CEA-CONF-2905) SEPARATION OF MOLYBDENUM AND TUNGSTEN BY A LIQUID–LIQUID ION-EXCHANGE METHOD. Esnault, F.; Robaglia, M.; Latard, J. M.; Demarthe, J. M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). [nd]. 29p. (CONF-740917-7). Dep. NTIS (US Sales Only) $4.50.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A process for the recovery of molybdenum values and tungsten values from a molybdenum contaiminated alkaline solution of tungsten values was carried out on a laboratory scale. This process includes acidifying the solution to a pH of 3 to 3.5 and contacting the solution with an organic extractant bis(2-ethyl hexyl) phosphoric acid, diluted in an inert hydrocarbon in the presence of ethyl-2-hexanol-1. Thus molybdenum is selectively extracted more readily when the tungsten concentration is low. Then molybdenum is stripped by an aqueous ammonia solution. The mother liquor, now molybdenum free, is contacted with an amine dissolved in an organic diluent capable of forming a tungstate amine complex. Then tungsten is stripped by an aqueous ammonia solution. (auth)

29019 (DP-1058(Del.)) EXTRACTION OF TRITIUM FROM LITHIUM ALUMINATE TARGETS. Kishbaugh, A. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Aug 1966. Contract AT(07-2)-1. 36p. Dep. NTIS $5.00.

Tritium can be extracted satisfactorily from lithium aluminate targets by heating at 850°C in a vacuum for 10 hours; less than 0.1% of the tritium remains in the residue. (auth)

29020 SEPARATION OF BISMUTH FROM ACCOMPANYING ELEMENTS BY EXTRACTION WITH DI-2-ETHYLHEXYLDITHIOPHOSPHORIC ACID. Yukhin, Yu. M.; Levin, I. S.; Meshkova, N. M. (Inst. of Physico-Chemical Principles of Processing Mineral Raw Materials, Novosibirsk, USSR). Zh. Anal. Khim.; 30: No. 1, 99-102(Jan 1975). (In Russian).

Extraction of bismuth with di-2-ethylhexyldithiophosphoric acid from solutions of mineral acids can be used for its separation from large amounts of alkali, alkaline earth, rare earth metals, Al, Ga, Ti(IV), Cr(III), Mn(II), Zr, Zn, Tl(I), Sn(II), Ag, Au(III), Hg(II) and other elements. A procedure has been worked out of determining microamounts of bismuth in various materials. (auth)

29021 ANION AND DILUENT STABILIZATION OF TRIBUTYL PHOSPHATE AND TRISETHYLHEXYL PHOSPHATE COMPLEXES IN THE EXTRACTION OF $HAuCl_4$, $HReO_4$, HI, AND HBr. Bucher, J. J.; Zuehl, R.; Diamond, R. M. (Univ. of California, Berkeley). J. Inorg. Nucl. Chem.; 37: No. 1, 211-220(Jan 1975).

The extraction of $HAuCl_4$, $HReO_4$, HI, and HBr by dilute solutions (≤0.4M) of tributyl phosphate and tris-ethylhexyl phosphate in isooctane, CCl_4, benzene and 1,2-dichloroethane was examined. From acid distribution data and IR spectra of the organic phases, it was concluded that the extraction of strong acids fit the hydronium-ion-core model. It was demonstrated that, in addition to the influence of the diluent, the acid anion also played a role in determining the ratio of the step-wise complexes, with the more basic anions (I^-, Br^-) favoring lower trialkyl phosphate solvation numbers. Differences between TBP and TEHP in solvating the (hydrated) hydronium cation also were demonstrated. (auth)

29022 TEMPERATURE EFFECTS IN SYNERGISTIC SOLVENT EXTRACTION. Kandil, A. T.; Aly, H. F.; Raieh, M.; Choppin, G. R. (Atomic Energy Establishment, Cairo). J. Inorg. Nucl. Chem.; 37: No. 1, 229-232(Jan 1975).

The extraction of Eu(III) and Tm(III) has been studied in mixed systems of TTA + TBP and TTA + AA (TTA = 2-thenoyltrifluoroacetone; TBP = tributylphosphate; AA = acetylacetone). The formation constants of $Eu(TTA)_3$, $Eu(TTA)_3(TBP)_2$, $Eu(TTA)_3(AA)$, $Tm(TTA)_3$, $Tm(TTA)_3(TBP)$ and $Tm(TTA)_3(AA)$ were measured as a function of temperature to obtain free energy, enthalpy and entropy changes. The thermodynamic parameters support a mechanism for synergism in which the coordination number of the lanthanide ion expands when $Ln(TTA)_3$ forms $Ln(TTA)_3(S)_n$ where S is TBP or AA. (auth)

29023 AMINE OXIDES AS SOLVENTS FOR URANIUM, THORIUM, AND SOME FISSION PRODUCTS. Ejaz, M.; Carswell, D. J. (Pakistan Inst. of Nuclear Science of Tech., Rawalpindi). J. Inorg. Nucl. Chem.; 37: No. 1, 233-237(Jan 1975).

A general survey of the extraction behavior of two amine oxides, 4-(5-nonyl)pyridine oxide and trioctylamine oxide has been made for uranium, thorium and some fission products from three acid media, HNO_3, HCl and H_2SO_4 over the concentration range of 0.01 to 10 M. Distribution data are presented as log-log plots of partition coefficients vs. molarity. Some separations for radiochemical and general analytical application are proposed. (auth)

29024 ANTIMONY(V)-HEXACYANOFERRATE(II) FOR SELECTIVE SEPARATION OF STRONTIUM. Boeckl, R.; Lieser, K. H. (Technische Univ. Darmstadt (F. R. Germany). Fachbereich Anorganische Chemie und Kernchemie). Radiochim. Acta; 20: No. 1/2, 51-54(1973). (In German).

The preparation and the properties of antimony(V)-hexacyanoferrate(II) are described. The capacity for strontium ions is 1.7 mVal/g. The distribution coefficients for Cs^+, Sr^{2+}, and Ce^{3+} were determined at various HNO_3 concentrations (0.1–3n). The separation factors Sr^{2+}/Cs^+ and Sr^{2+}/Ce^{3+} were found to be $> 1.4 \times 10^2$ within the HNO_3 concentration range investigated. Also the time dependence of the strontium ion uptake was measured. The practical applicability of the compound was studied by using columns. (auth)

29025 RECOVERY OF URANIUM FROM WET-PROCESS PHOSPHORIC ACID BY EXTRACTION WITH OCTYLPHENLPHOSPHORIC ACID. Hurst, F. J.; Crouse, D. J. (Oak Ridge National Lab., TN). Ind. Eng. Chem., Prod. Res. Develop.; 13: No. 3, 286-291(Jul 1974).

Commercial wet-process phosphoric acid that is produced from Florida phosphate rock contains 0.1–0.2 g of uranium/l. and represents a potentially substantial source of uranium. A process for recovering the uranium by extraction with a mixture of mono- and dioctylphenylphosphoric acids in an aliphatic diluent has been developed and demonstrated successfully in bench-scale mixer-settler tests. The uranium is recovered from the solvent by contacting it with 10 M H_3PO_4 containing sodium chlorate; the chlorate oxidizes the uranium to the less-extractable hexavalent state and effects its transfer to the aqueous phase. The strip solution can be loaded with uranium to 15–20 g/l., a factor of 100 or more richer in uranium than the original acid. These solutions are highly amenable to processing in a second cycle with the synergistic extractant combination of di(2-ethylhexyl) phosphoric acid plus trioctylphosphine oxide. The uranium is stripped from this solvent with ammonium carbonate solution and recovered as a high-grade (>98% U_3O_8) product. (auth)

29026 ADVANCES IN EXTRACTION CHROMATOGRAPHY. Ma, E. H. (Shanghai Inst. of Organic Chemistry). K'o Hsueh T'ung Pao; 19: No. 11, 490-500(15 Nov 1974).

Advances in extraction chromatography are surveyed. The introduction of tri-n-butylphosphate (TBP) as a solvent extractant for zirconium and niobium was followed by a rapid expanding series of investigations of extraction chromatography. More than 300 papers have been published on this subject. Chinese scientists have contributed more than 50 articles. Applications of extraction chromatography for separation of (1) alkali metals and alkaline earths, (2) copper, (3) precious metals, (4) rare earths, (5) transplutonium elements, (6) radioactive elements, and (7) isotopes of lithium are reviewed. (JPRS)

29027 ABSORPTION OF MINOR ELEMENTS ON HYDROUS METAL OXIDES IN SEA WATER. Liu, C. P.; Liu, L. S. (Shantung Coll. of Oceanography, China). K'o Hsueh T'ung Pao; 19: No. 11, 514-520(15 Nov 1974).

A method based on a modified version of the Sips equation is presented to calculate the distribution of the absorption of minor elements on hydrous metal oxides in sea water. The amount of minor elements per unit surface area is represented as a function of the concentration of minor elements in sea water. The application of this method to the following 3 actual cases is presented: (1) minor elements such as molybdenum and tungsten on hydrous ferrous oxides, (2) minor elements such as boron and boric acid on hydrous magnesium oxide, and (3) minor elements such as uranium on titanium oxide. (JPRS)

29028 SEPARATING METAL VALUES BY SELECTIVE EXTRACTION. Hazen, W. C.; Hadzeriga, P. (to Molybdenum Corp. of America). US Patent 3,857,919. 31 Dec 1974. Filed date 18 Jun 1969. 10p.

Double solvent extraction process is described wherein an aqueous solution of difficult to separate rare earth metals is alternately contacted with two different solvents and at least one metal is preferentially extracted by the one solvent and at least one other metal is preferentially extracted by the other solvent. (Official Gazette)

29029 DISTRIBUTION COEFFICIENT CORRELATIONS FOR PREDICTING THE EXTRACTION EQUILIBRIA OF LUTETIUM–YTTERBIUM AND LUTETIUM–THULIUM BINARY RARE EARTH MIXTURES BETWEEN DI(2-ETHYLHEXYL)PHOSPHORIC ACID IN AMSCO AND AQUEOUS HYDROCHLORIC ACID SOLUTIONS. Thomas, N. E.; Burkhart, L. E. (Ames Lab., Iowa). Ind. Eng. Chem., Fundam.; 13: No. 4, 366-372(Nov 1974).

Equilibrium data were obtained for the extraction of the binary rare earth mixtures lutetium–ytterbium and lutetium–thulium from 5 M HCl–H_2O solutions by 1 M di(2-ethylhexyl) phosphoric acid in Amsco odorless mineral spirits. The separation factors for the above binary mixtures were substantially constant with respect to mixture composition, the arithmetic averages for $\beta_{Lu,Tm}$ and $\beta_{Lu,Yb}$ being 6.96 and 1.82, respectively. Empirical correlations for predicting total distribution coefficients for the Lu–Yb and Lu–Tm mixtures were developed. These correlations are comparable to one developed earlier for Yb–Tm mixtures and

have direct applications in the design and optimal control of heavy rare-earth fractionation columns in which di(2-ethylhexyl) phosphoric acid in Amsco and HCl in water are employed as liquid solvents. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 29194, 30236, and 30830.

29030 (HEDL-TME-75-7) REACTION OF SODIUM AND NaK WITH MOBILTHERM LIGHT OIL. Hilliard, R. K.; Muhlestein, L. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-2170. 48p. Dep. NTIS $4.00.

The compatibility of "Mobiltherm Light" heat transfer oil with sodium and NaK under simulated accident conditions was demonstrated. Kilogram quantities were mixed at various temperatures (to 800°F) in air and in nitrogen atmospheres. Chemical reactions between the oil and the liquid metals were shown to have negligible effects on the accident severity. (auth)

29031 (TID/SNA-1195) PROPERTIES OF PARA-HYDROGEN. Revision 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1964. 51p. Dep. NTIS $5.75.

Data on parahydrogen include equation of state, general PVT data, transport properties, surface tension, sonic velocity, and dielectric constant. These data are presented in curves and tables. (LK)

29032 (UCRL-15743) STRESS-STRAIN BEHAVIOR OF POLYCRYSTALLINE NaCl TO 3.2 GPa. Heard, H. C.; Abey, A. E.; Bonner, B. P.; Duba, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1975. Contract W-7405-Eng-48. 19p. Dep. NTIS $4.00.

The mechanical properties of dry, fine-grained salt (NaCl) containing about 1% porosity have been determined at pressures up to 3.2 GPa at 25°C. Measurements include: 1) hydrostatic pressure-volume (P-V) behavior on loading to and unloading from 0.8 GPa; 2) quasi-hydrostatic P-V relationship to 3.2 GPa; 3) shear strengths to strains of 0.10 at confining pressures to 0.4 GPa; 4) loading and unloading moduli determined in uniaxial stress and uniaxial strain at pressures to 0.7 GPa; and 5) ultrasonic velocities at pressures to 0.4 GPa. The hydrostatic and quasi-hydrostatic loading show slight pore crush-up beginning at 200 MPa. At the maximum pressure, $\Delta V/V_0$ of 0.11 is indicated. Unloading is identical to the loading path down to about 400 MPa; a permanent compaction of 0.007 is observed after unloading to 0.1 MPa. Although shear strengths increase slightly with strain, they are nearly constant at 40 to 45 MPa, independent of pressure. In uniaxial stress tests, brittle fracture occurs in the salt at pressures below 10 MPa; ductile behavior is noted at all higher pressures. Failure in the brittle regime is preceded by volumetric expansion (dilatancy). Compactions of 0.005 to 0.01 always accompany ductile behavior in uniaxial stress loading. At pressures less than 100 MPa, the uniaxial-strain loading path nearly intersects the failure envelope (uniaxial stress). At higher pressures, the shear stress diminishes slightly; the loading path then loads parallel to the failure envelope. The dynamic bulk modulus (K) determined from ultrasonic measurements increases from 19 to 23 GPa as pressure is raised to 10 MPa. Here K decreases slightly to pressures of 100 MPa. This is followed by a gentle increase to 24 GPa at 400 MPa pressure. The dynamic shear modulus (μ) increases monotonically from 12.5 to 16 GPa over the same pressure range. Static values for K and μ show much wider variations with pressure and are usually lower than the dynamic values. (auth)

29033 SINTEZ I SVOISTVA SOEDINENII NIOBIYA, TANTALA I TITANA. (Synthesis and Properties of Compounds of Niobium, Tantalum, and Titanium). Shveikin, G. P. (ed.). Moscow; Izdatel'stvo (1974). 316p.

Data on the conditions for the synthesis of the phosphates, arsenates, arsenites, and sulfates of Ti, Nb, and Ta, the titanates of Na and K, and the niobates and tantalates of the rare earth elements and the 3d elements are compiled. Special attention is given to questions of phase identification and the physical-chemical and chemical properties of the individual compounds. The formation of condensed compounds from solutions and from high-temperature interaction processes in the solid phase is examined. (tr-auth)

29034 HYDROTHERMAL FORMATION OF FERRITE SPINELS. Gainsford, A. R.; Sisley, M. J.; Swaddle, T. W.; Bayliss, P. (Calgary Univ., Alberta). Can. J. Chem.; 53: No. 1, 12-19(1 Jan 1975).

Ferrite spinels are relevant to the problem of transport of radioactivity in water-cooled nuclear reactors. The possibility of forming spinel-type ferrites MFe_2O_4 from $M(OH)_2$ or MO and α-FeO(OH) (geothite) or α-Fe_2O_3 (hematite) under hydrothermal conditions up to 350° has been investigated experimentally for M = Mg, Ca, Mn, Co, Ni, Cu, and Zn. Formation of MFe_2O_4 was observed for M = Mn (jacobsite), Co, Ni (trevorite), and Zn (franklinite), and was in general favored by high temperatures, high pH, and the presence of $NaNO_3$ or especially, NaCl in solution. α-FeO(OH) is more reactive than α-Fe_2O_3, but generally converts to the latter at 220 to 260°, independently of pH, in neutral or alkaline media. Interpretation of the results is complicated by the ion-exchanging properties and varying degrees of crystallinity of $M(OH)_2$, and by the tendency of $M(OH)_2$ to decompose to MO or to be oxidized at the higher temperatures. Nevertheless, the order of reactivity M = Co ≥ Mn > Ni > Zn > (Mg, Ca, Cu) in MFe_2O_4 formation is generally valid. The formation of MFe_2O_4 is limited by kinetic rather than thermodynamic factors for the various M listed (except Cu). (auth)

29035 KOORDINATSIONNAYA KHIMIYA REDKOZEMEL'NYKH ELEMENTOV. Metodicheskoe Posobie. I. (Coordination Chemistry of Rare Earth Elements. Methods Manual. I). Spitsyna, V. I.; Martynenko, L. I. Moscow; Izdatel'stvo (1974). 171p.

A series of lectures for advanced students in inorganic chemistry and the complex chemistry of rare earth elements are compiled. The lectures are designed to present the characteristics of the complex formation of these elements and to discuss physical chemistry methods of studying them, such as pH measurements, spectrophotometry, ir spectrometry, and thermogravimetry. Extraction and chromatographic separation of rare earth mixtures including U and Th, based on complex formation of rare earths, is also considered. (JSR)

29036 SOLUBILITIES OF HYDROGEN, DEUTERIUM, AND HELIUM IN MOLTEN Li_2BeF_4. Malinauskas, A. P.; Richardson, D. M. (Oak Ridge National Lab., TN). Ind. Eng. Chem., Fundam.; 13: No. 3, 242-245(Aug 1974).

Solubilities of H_2, D_2, and He in molten Li_2BeF_4 have been measured. Values of the Ostwald coefficient K_c (equilibrium ratio of gas concentration in the dissolved state to the gas-phase concentration) which were determined for He can be described over the temperature range 773-1073°K by the expression $\log (10^3 K_c) = \log T - (1177/T) - 0.7954$, whereas the combined data for H_2 and D_2 can be represented over the temperature range 773-973°K by the expression $\log (10^3 K_c) = \log T - (1535/T) - 0.7684$. (auth)

29037 REACTION OF IODINE WITH CONCENTRATED NITRIC ACID. Mailen, J. C.; Tiffany, T. O. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 37: No. 1, 127-132 (Jan 1975).

The oxidation of iodine by hyperazeotropic nitric acid was shown to proceed in at least two steps; the kinetic data are consistent with the first step producing iodine with a valence of +1, and later reactions finally yielding iodine with a valence of +5. The data are analyzed assuming the two following reactions: $I_2 + 3HNO_3 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} 2I^+ + 2NO_3^- + HNO_2 + H_2O$ and $I^+ + 6HNO_3 \underset{k_4}{\overset{k_3}{\rightleftharpoons}} I^{5+} + 4NO_3^- + 2HNO_2 + 2H_2O$. Numerical values were determined for k_1 and k_3 at 25°C and in 16 to 21 M nitric acid. The defining equations for these constants are: $dC_{I_2}/dt = -k_1 C_{I_2}$ and, $dC_{I^+}/dt = -k_3 C_{I^+}$. The values for these constants are fitted by the following least-squares-determined equations for nitric acid concentrations above 16 M: $\ln k_1 = -112.5 + 38.28 \ln C_{HNO_3}(M)$ and $\ln k_3 = -45.25 + 13.69 \ln C_{HNO_3}(M)$ where the units of k are sec^{-1}. (auth)

29038 COMPLEX OXIDES CONTAINING DIVALENT EUROPIUM. II. $Eu(M,M')O_3$ Phases. Greedan, J. E. (Dalhousie Univ., Halifax, Nova Scotia); McCarthy, G. J.; Sipe, C. Inorg. Chem.; 14: No. 4, 775-779(Apr 1975).

The redox guidelines developed previously for the prediction of new complex europium (II) oxides are extended to $Eu(M,M')O_3$ perovskites. Attempts to prepare nearly 40 new europium oxides are described in a systematic experimental test of the guidelines. Fourteen compounds are actually found to be stable under the conditions of preparation. In terms of the combination of ions occupying the sixfold site these are (Mg^{II},W^{VI}), (Mn^{II},W^{VI}), (Al^{III},Ta^V), (Ti^{III},Ta^V), (V^{III},Ta^V), (Cr^{III},Ta^V), (Eu^{III},Ta^V), (Ti^{III},Nb^V), (V^{III},Nb^V), (Cr^{III},Nb^V), (Mg^{II},Ta^V), (Mn^{II},Ta^V), (Mg^{II},Nb^V), (Mn^{II},Nb^V). Precision cell constants are reported for all of these phases. Agreement between the redox guidelines and experiment is discussed as are the implications of these results for the existence of new nonperovskite oxides of Eu^{2+}. (auth)

29039 TEMPERATURE DEPENDENCE OF THE NUCLEAR QUADRUPOLE RESONANCE SPECTRA OF PERRHENATES AND PERIODATES. Johnson, R. A.; Rogers, M. T. (Michigan State Univ., East Lansing). pp 297-313 of Advances in Nuclear Quad-

ruple Resonance. Volume I. Smith, J. A. S. (ed.). London; Heyden and Sons (1974).

The temperature dependence of the nuclear quadrupole resonance coupling constants for ^{127}I in $NaIO_4$ and for ^{187}Re in $NaReO_4$, $KReO_4$ and $AgReO_4$ has been measured in the range 16°K to 300°K. The low frequency lattice vibrations and their temperature coefficients, determined from laser Raman and far-infrared spectra, are tabulated. The Bayer theory, modified to include temperature dependence of the lattice modes, has been used to calculate the temperature dependence of the coupling constants. In each case the experimental values show a larger temperature coefficient than calculated and the deviations vary from compound to compound. We conclude that the change in field gradient with expansion of the lattice, which has been neglected in our calculations, must be important and that its magnitude varies with cation even in a series of compounds with the same type structure (Scheelite). If, instead of the experimental lattice frequencies and their temperature coefficients, we use these as adjustable parameters and fit the experimental curves, excellent agreement is obtained. However, the physical meaning of the parameters which result is not clear and the actual values depend on the curve fitting procedure used; the values of ν_0 obtained are quite close to those from the Bayer–Brown theory but the values of ω^0 are below any observed librational frequency. Further, the amount by which the calculated curves lie above the experimental curves has been compensated for in the empirical Bayer method by selection of a value of ω^0 sufficiently low to produce approximate agreement. (auth)

Isotope Effects

Refer also to abstracts 29074 and 30834.

29040 (CEA-CONF-2778) INFRARED SPECTROMETRY OF ISOLATED CHLOROPHYLLS: ASSOCIATION CONSTANTS AND ISOTOPIC EFFECTS. Leicknam, J. P.; Henry, M.; Plus, R.; Gillet, R.; Kleo, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Recherche et Analyse). 28 Aug 1974. 20p. (CONF-740946-4). Dep. NTIS (US Sales Only) $4.00.

From 3rd international congress on photosynthesis; Rehovot, Israel (2 Sep 1974).

Four types of chlorophyll (Ch) a molecules with quite different electron accepting reactivities were detected and the following correlations are proposed: (1) The weak reactivity of the species a′ could correspond to a particularly stable Mg bonding state, Sp^2d (or Sp), placing Mg inside or very close to the tetrapyrrolic plane. (2) In the case of monomers a, slightly more reactive, the Mg could lie a little farther outside the tetrapyrrolic plane, Sp (or Sp^2d), with some orbital deformation. (3) The Mg of L-Ch (L is other polar molecular) complexes and those involved in the bonds of polymers $(Ch)_n$ would have an Sp^2 type hybridization. (4) Finally the Mg not involved in the intermolecular bonds of polymers $(Ch)_n$ are certainly right outside the tetrapyrrolic plane with a particularly deformed Sp (or Sp^2d) hybridization. For $(Ch)_n$ and L-Ch complexes the 26 Mg isotopic effect observed does not disagree with these hypotheses. These preliminary results show in any case that by a quantitative study of Ch complexing combined with the use of isotopically labelled molecules it should be possible to define more accurately the electronic state of the central Mg of these molecules. Meanwhile the hypotheses put forward on the basis of this work concerning the distortion of the tetrapyrrolic ring, its repercussion on the electron structure and the hybridizations of the central Mg seem to be corroborated by recent work on oxido-reduction reactions and ESR spectra of magnesium-containing tetrapyrrolic complexes and Ch itself. (auth)

29041 FOURIER TRANSFORM NMR IN LIQUIDS AT HIGH PRESSURE. III. SPIN–LATTICE RELAXATION IN TOLUENE-d_8. Wilbur, D.J.; Jonas, J. (Department of Chemistry, School of Chemical Sciences and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 62: No. 7, 2800-2807 (1 Apr 1975).

The spin–lattice relaxation time (T_1) of both ring and methyl deuterons have been measured in toluene-d_8 by the Fourier transform inversion recovery method. Measurements were made over the temperature range −35 to 200°C, and over the pressure range 1 bar to 4 kbar. Viscosities and densities were also measured over most of this range. The T_1 data are analyzed in terms of correlation times for isotropic overall molecular reorientation and internal rotation of the methyl group. Using pressure as a variable enables us to separate effects of density and temperature on overall and internal motion of the toluene molecule. Activation energies and activation volumes are reported. The experimental data are interpreted in terms of various theoretical models for the motional dynamics. The rotational diffusion model and the Enskog theory are used to discuss overall motions. For the case of internal motion of the methyl groups, the Langevin model is also considered. Large angle reorientation appears to be important in the overall motion of the toluene molecule at temperatures above 50°C, whereas the motion of the methyl group is characterized by large angle steps even at lower temperatures. At high temperatures, the motion of the methyl group approaches that of a free rotor. (auth)

29042 ENERGY TRANSFER IN CO $A^1\Pi$, $v=9$. I. QUENCHING AND ISOTOPE EFFECTS. Melton, L.A.; Yiin, K. (Department of Chemistry, University of Texas at Dallas, Richardson, Texas 75080). J. Chem. Phys. 62: No. 7, 2860-2868 (1 Apr 1975).

The atomic oxygen line at 1306 Å excites $^{12}C^{16}O$ $A^1\Pi$, $v=9$, $J=22$ and $^{12}C^{18}O$ $A^1\Pi$, $v=9$, $J=6$. For $^{12}C^{16}O$ $A^1\Pi$, $v=9$, the following total quenching rates have been measured (units, cm^3 sec^{-1}): $^{12}C^{16}O$, 8.7×10^{-10}; $^{12}C^{18}O$, 8.6×10^{-10}; He, 6.9×10^{-12}; Ne, 2.0×10^{-12}; Ar, 2.4×10^{-11}; Kr, 1.2×10^{-10}; Xe, 4.8×10^{-10}; H_2, 2.0×10^{-10}; D_2, 1.6×10^{-10}; SF_6, 1.4×10^{-10}. For $^{12}C^{18}O$, $A^1\Pi$, $v=9$, the following quenching rates have been measured: $^{12}C^{16}O$, 6.7×10^{-10}; $^{12}C^{18}O$, 1.3×10^{-9}; He, 3.7×10^{-12}; Ne, 7.9×10^{-13}; Ar, 2.2×10^{-11}; Kr, 2.2×10^{-10}; Xe, 5.4×10^{-10}; H_2, 2.6×10^{-10}; D_2, 1.6×10^{-10}; SF_6, 1.4×10^{-10}. It is probable that He, Ne, Ar, and Kr quench CO $A^1\Pi$, $v=9$ by mixing the $A^1\Pi$ state with nearby electronic states and that CO, Xe, H_2, D_2, and SF_6 quench both by mixing the $A^1\Pi$ state and by reaction and/or electronic energy transfer. (auth)

29043 ION CYCLOTRON RESONANCE STUDIES ON THE REACTION OF H_2^+ AND D_2^+ IONS WITH VARIOUS SIMPLE MOLECULES AND HYDROCARBONS. Kim, J.K.; Huntress, W.T. Jr. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Chem. Phys. 62: No. 7, 2820-2825 (1 Apr 1975).

The rate constants and product distributions for the reactions of H_2^+ ions with N_2, O_2, and CO, and for the reactions of both H_2^+ and D_2^+ ions with CH_4, CD_4, NH_3, H_2O, H_2S, C_2H_2, C_2H_4, and C_2H_6 have been measured by ion cyclotron resonance methods. Proton transfer dominates in the reaction with diatomic molecules, and charge transfer dominates in the reaction with polyatomic molecules. However, a significant amount of charge transfer was observed in the reaction of H_2^+ ions with O_2 and CO, and a significant amount of proton transfer was observed in the reaction of H_2^+ ions with H_2O. The reaction with methane to form methyl cations appears to involve a superposition of both dissociative charge transfer and proton transfer followed by H_2 elimination. The extent of fragmentation resulting from H_2^+ charge exchange to CH_4 is on the order of that observed in photoionization and Penning ionization of CH_4 at 16 eV total available energy, and much larger than is observed in electron impact of CH_4 at 16 eV. (auth)

29044 THEORY OF VIBRATIONAL RELAXATION IN THE INVERTING MOLECULES, NH_3 AND ND_3. Starr, D.F.; Decius, J.C. (Department of Chemistry, Oregon State University, Corvallis, Oregon 97331). J. Chem. Phys. 62: No. 7, 2808-2819 (1 Apr 1975).

The exceptionally rapid vibrational energy relaxation in ammonia has led to the speculation that the inversion motion is responsible for the higher rate of collisional energy exchange than in related molecules. Exact numerical solution of the scattering equations has been carried out utilizing an atom–atom exponential repulsive potential for one dimensional collisions, with emphasis upon the comparison of models whose internal energy is described by (a) an ordinary harmonic oscillator (noninverting model) and (b) the states that accurately describe the vibrational motion for double minimum potential (inverting model). Although the transition probabilities for the 0^+, 0^- and 1^+, 1^- states are high at thermal energies, such transitions do not make a large contribution to the relaxation time found from acoustic experiments. The speed of the observed processes is attributed principally to (a) the "acceleration" effect which is a consequence of the intermolecular potential of polar molecules and (b) the high impact velocities of rotating molecules with low moments of inertia. (auth)

29045 AN EXPLORATORY STUDY OF REACTANT VIBRATIONAL EFFECTS IN $CH_3 + H_2$ AND ITS ISOTOPIC VARIANTS. Chapman, S.; Bunker, D.L. (Department of Chemistry, University of California, Irvine, California 92664). J. Chem. Phys. 62: No. 7, 2890-2899 (1 Apr 1975).

An empirically calibrated potential energy surface, obtained previously [J. Chem. Phys. 61, 21 (1974)], was used in a trajectory study of the effect of reactant energy partitioning on cross section for $CH_3 + H_2 \rightarrow CH_4 + H$. Artificial variations in the barrier position, and artificial and naturally occuring changes in the H masses, were also made. For natural $CH_3 + H_2$, H_2 vibration enhances and CH_3 out-of-plane bending depresses the cross section, at constant (25 kcal) translational energy of approach. The isotope substitution and barrier position effects are more complex and not predictable from triatomic A + BC generalizations. The relationship of these results to experimental ones is discussed. (auth)

29046 CALCULATION OF THE LATTICE MODES OF THE ISOTOPIC CO_2 MOLECULES AND THEIR REDUCED PARTITION

FUNCTION RATIOS. Lee, M. W. (Department of Chemistry, University of Rochester, Rochester, New York 14627). J. Chem. Phys. 62: No. 6, 2094-2097 (15 Mar 1975).

The lattice dynamics of a unit cell with four CO_2 molecules have been calculated from the Raman, infrared, and inelastic neutron scattering spectra. The vibrational frequencies of the isotopic $^{12}C^{16}O_2$, $^{13}C^{16}O_2$, $^{12}C^{18}O_2$, and $^{12}C^{16}O^{18}O$ are calculated in a pseudoharmonic oscillator approximation. From these vibrational frequencies and the gas phase frequencies, the reduced partition ratios of the various isotopic CO_2 molecules are calculated in good agreement with experiment. The lattice dynamics calculation are also compared with calculation from a simple cell model. It is shown that the simple cell model is an excellent approximation for the calculation of the reduced partition function ratios as a consequence of the large separation between the eigenvalues of the internal and external modes, the magnitude of the external eigenvalues relative to kT, and the symmetries of the lattice and the molecule. (auth)

29047 CALCULATION OF HEAVY–ATOM KINETIC ISOTOPE EFFECTS: APPLICATION OF THE HIGH TEMPERATURE APPROXIMATION TO MODELS WITH THREE–ELEMENT REACTION COORDINATES. Wei, G.; Yankwich, P.E. (Department of Chemistry, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 62: No. 6, 2200-2208 (15 Mar 1975).

Calculations of the temperature dependent factor (TDF) in the isotopic ratio of specific rate constants k_{12_C}/k_{13_C} for the decomposition of formic acid were carried out exactly and in the first order and second order high temperature approximations for a variety of reaction coordinate eigenvectors comprising displacements in three internal coordinates. The principal objective was to determine the consistency, if any, with which the features and general value levels of surfaces obtained by plotting exact values of ln(TDF) as functions of RCEV composition could be predicted from the corresponding surfaces in the first and second order approximations. The first order approximation is not usually a reliable guide to ln(TDF) for either value or gradients of value as functions of reaction coordinate composition at temperatures $\leq$ 1000°K. The second order approximation is often a reliable guide to gradients in the value of ln(TDF) in the range 1000–300°K, but the indications of value may be crude. (auth)

29048 PHASE EQUILIBRIUM ISOTOPE EFFECTS IN MOLECULAR SOLIDS AND LIQUIDS. VAPOR PRESSURES OF THE ISOTOPIC CARBON DIOXIDE MOLECULES. Bilkadi, Z.; Lee, M.W.; Bigeleisen, J. (Department of Chemistry, University of Rochester, Rochester, New York 14627). J. Chem. Phys. 62: No. 6, 2087-2093 (15 Mar 1975).

The vapor pressures of samples of CO_2 enriched in ^{13}C and ^{18}O have been compared with normal CO_2 over the temperature range 154–217°K. Over the entire temperature range the order of the vapor pressures is $P_{^{13}CO_2} > P_{^{13}CO_2} > P_{C^{18}O_2}$. The results are explained by the small shift in the internal vibrations, which dominate the carbon isotope effect, and hindered rotation in the solid and liquid. While the isotope effect on melting is small for carbon substitution, it is found to be large for oxygen substitution. Hindered rotation is the major contribution to the oxygen isotope effect in the solid, while the hindered translation is the most important contribution to the oxygen isotope effect in the liquid. Model calculations of the logarithm of the reduced partition function ratios of the solid and liquid, $\ln(f_c/f_g)$, are made in an anharmonic version of the Stern–Van Hook–Wolfsberg cell model. These calculations give good agreement with the experimentally determined $\ln(f_c/f_g)$ values for the solid, liquid–vapor isotope fractionation measurements of Grootes, Mook, and Vogel, and lattice dynamic calculations. (auth)

29049 RECOMBINATION OF IODINE ATOMS BY FLASH PHOTOLYSIS OVER A WIDE TEMPERATURE RANGE. VI. I_2 IN HCl, DCl, HBr, AND SO_2. Chang, H.W.; Burns, G. (Department of Chemistry, University of Toronto, Toronto M5S 1A1, Ontario, Canada). J. Chem. Phys. 62: No. 6, 2426-2428 (15 Mar 1975).

Recombination of iodine atoms in an excess of HCl, DCl, HBr, and SO_2 was studied over a wide temperature range using flash photolysis technique. The following data were obtained: $\log k^{HCl}_r = 10.287 - 2.798 \log(T/300)$, (300–1000°K); $\log k^{DCl}_r = 10.193$, (at 300°K); $\log k^{HBr}_r = 10.274 - 2.956 \log(T/300)$, (300–570°K); $\log k^{SO_2}_r = 10.272 - 2.574 \log(T/300)$, (300–1070°K). The results suggest that the recombination is dominated, at least at lower temperatures, by the radical–molecule complex mechanism, which requires that the iodine atom forms a weakly bound complex with the third body, i.e., HCl, DCl, HBr, and SO_2. In the case of iodine recombination in SO_2, simple van der Waals forces appear to contribute to stability of the $I–SO_2$ complex. In the case of iodine recombination in hydrogen halides, the intermediates I–(HX) involved in the reaction appear to be unstable species, in which iodine atoms are interacting with both atoms HX, rather than stable bihalide radicals IHX observed by matrix isolation technique at low temperature. Hydrogen bonding, as well as weak chemical interactions between iodine atom and halogens in hydrogen halides, may contribute to stability of I–(HX) intermediates. (auth)

29050 DISSOCIATION CONSTANT OF BENZOIC ACID IN $H_2O + D_2O$ MIXTURES. Lowe, B. M.; Smith, D. G. (Univ. of Edinburgh). J. Chem. Soc., Faraday Trans., I; 71: No. 2, 389-397(1975).

The dissociation constant of benzoic acid has been determined at 25°C in ordinary water and in $H_2O + D_2O$ mixtures by conductance measurements and by precise e.m.f. measurements with glass and silver-silver chloride electrodes in a cell without liquid junctions. The isotope effects ΔpK_n (= $pK_n - pK_H$) obtained by the two methods are in agreement and are shown to support the simple equilibrium theory of solvent isotope effects. The values of pK_H and pK_D obtained from the e.m.f. measurements are 4.201 ± 0.004 and 4.693 ± 0.004 respectively. (auth)

29051 RAMAN SPECTRA OF POLYCRYSTALLINE ACIDS CH_3COOH, CH_3COOD, CD_3COOH, CD_3COOD AT 90 DEG K. Foglizzo, R.; Novak, A. (Centre National de la Recherche Scientifique, 94 - Thiais (France). Lab. de Chimie Physique). J. Chim. Phys.; 71: No. 10, 1322-1328(Oct 1974). (In French).

The Raman spectra of polycrystalline samples of CH_3COOH, CH_3COOD, CD_3COOH, and CD_3COOD at 90°K were investigated in the 4000 to 40 cm^{-1} range. An assignment of the intramolecular vibrations is given; the Raman and infrared data are compared. Seven bands due to external vibrations five of which correspond to intermolecular O-H...O hydrogen bond vibrations were identified. The structure and band-width of OH and OD stretching bands are discussed; the interpretation of the sub-bands in terms of combinations and overtones of intramolecular vibrations was confirmed. The half-bandwidth of the OH stretching band can be reduced an order of magnitude by lowering the temperature and by deuteration. The anharmonicity of the νOH oscillator appears thus to be factor determining the intrinsic bandwidth. (FR)

29052 THE PARTIAL MOLAL VOLUMES OF SOME REPRESENTATIVE SOLUTES IN H_2O AND D_2O. Choi, Y. S.; Bonner, O. D. (South Carolina Univ., Columbia (USA). Dept. of Chemistry). Z. Phys. Chem. (Frankfurt); 87: No. 4/6, 188-197(Dec 1973).

2 figs.; 3 tabs.; 17 refs.

The partial molal volumes of eleven solutes were measured in D_2O as a function of concentration and in most instances as a function of temperature. Measurements were also made in H_2O solutions when they were unavailable in the literature for particular concentrations or temperatures. A pattern emerged for the differences of the partial molal volumes of salts in the two solvents, which could be correlated with spectral and other data for the same solutes and which indicated that a relationship exists between these differences and the solvent structure-altering properties of the solutes. (auth)

29053 NUCLEOPHILIC HETEROAROMATIC SUBSTITUTIONS. XXXVIII. Evidence for a Cyclic Mechanism in the Reaction of 2-Phenoxy-1,3,5-Triazine with Piperidine in Isooctane. Illuminati, G.; LaTorre, F.; Liggieri, G.; Sleiter, G.; Stegal, F. (Univ., Rome). J. Amer. Chem. Soc.; 97: No. 7, 1851-1855(2 Apr 1975).

The kinetics of piperidino dephenoxylation of 2-phenoxy-1,3,5-triazine in isooctane have been followed spectrophotometrically. The reaction follows third-order kinetics, is not base-catalyzed, is moderately speeded up by added 2-piperidone, and proceeds by a temperature-independent rate in the range 20–70°. A sizable direct kinetic hydrogen isotope effect is observed, when piperidine 1-d is used, that was found to decrease as the concentration of piperidine is increased. Out of several reaction paths, the results support a cyclic mechanism involving the participation of a second molecule of piperidine acting as a bifunctional catalyst. (auth)

29054 COMPETITIVE KETO–ENOLATE PHOTOCHEMISTRY IN THE 3-PHENYLISOCOUMARANONE SYSTEM. Padwa, A.; Dehm, D.; Oine, T.; Lee, G. A. (State Univ. of New York, Buffalo). J. Amer. Chem. Soc.; 97: No. 7, 1837-1845(2 Apr 1975).

The photochemistry of 3-phenylisocoumaranone (1) is markedly influenced by the tautomeric composition of the lactone in solution. Decarbonylation results from excitation of the keto tautomer using 2537-Å light. The transient o-quinone methide formed rapidly reacts with methanol to give o-hydroxybenzhydryl methyl ether (2). On further irradiation, 2 is converted into o-benzylphenol (3) and xanthene (4). Equilibrium concentrations of the enolate ion of 1 have been detected in methanol. By using 3130-Å light, the enolate ion can be selectively excited. The resulting excited state does not lose carbon monoxide but instead undergoes proton exchange with the solvent or reaction with molecular oxygen. In the presence of singlet oxygen, the ground-state enolate is also trapped to give o-hydroxybenzophenone (5) and 3-hydroxy-3-phenylisocoumaranone (6). The wavelength and solvent effects noted in this system suggest that certain carbonyl derivatives possess the potential for distinctive and competitive keto-enol photochemistry. (auth)

29055 KINETIC APPLICATIONS OF ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY. XVII. Secondary Deute-

rium Isotope Effect and the Absence of a Memory in the β Scission of a Tetra-Tert-Butoxyphosphoranyl. Griller, D.; Ingold, K. U. (National Research Council, Ottawa). J. Amer. Chem. Soc.; 97: No. 7, 1813-1816(2 Apr 1975).

The reaction of tri-tert-butyl phosphite with tert-butoxy radicals yields the phosphate and a tert-butyl radical via an intermediate tetra-tert-butoxyphosphoranyl radical. Using EPR spectroscopy and deuterium labeling, it has been shown that, at temperatures from 78 to −100°, this reaction occurs without any "memory" as to which tert-butoxy attacked the phosphite. However, the β scission of the phosphoranyl to phosphate and tert-butoxy exhibits a significant secondary β-deuterium isotope effect. After correction for the isotope effect involved in the disproportionation of tert-butyls ($k_d^{(CH_3)_3C}/k_d^{(CD_3)_3C} = 1.4 \pm 0.2$ from 80 to −20°, it being assumed that the combination rate constants $k_c^{(CH_3)_3C}$ and $k_c^{(CD)_3C}$ are equal), the isotope effect per deuterium for decay of the phosphoranyl can be represented by $\log (k_d^H/k_d^D) = -0.029 + 0.063/\theta$ where $\theta = 2.3RT$ kcal/mol. These isotope effects are discussed in relation to isotope effects in analogous reactions, and the advantages in terms of sensitivity and available temperature range of our procedure are pointed out. (auth)

29056 INVESTIGATION OF STERIC EFFECTS ON THE REACTIVITY OF NORBORNANONE-2 BY DETERMINING THE SECONDARY ISOTOPIC EFFECTS OF DEUTERIUM. Boyer, B. (Univ., Montpellier, France); Lamaty, G.; Roque, J. P.; Geneste, P. Rec. Trav. Chim.; 93: 260-264(Sep 1974). (In French).

The following compounds were prepared: 2-norbornanone-3d_1 exo, -3-d_1 endo, -3,3-d_2 and 5,6-d_2 endo; the rates of borohydride ion addition and of decomposition of bisulfite addition compounds were measured in order to explain the high exo side reactivity of norbornyl systems. In both reactions, there is no significant isotope effect due to deuteration at the 5,6 endo positions. This observation can result either from an absence of any steric interaction or from a non-bonded interaction potential much smaller than usually admitted. The protons in 3-endo and 3-exo positions are not equivalent towards the nucleophile approach. (NL)

Isotope Exchange and Isotope Separation

29057 (AEC-RD-8) REVISED TABULATION OF SULFUR-ISOTOPE ANALYSES. Austin, S. R. (USAEC Grand Junction Office, Colo. Resource Div.). Apr 1970. 48p. Grand Junction Operations Office.

Results are reported as $\delta^{34}S$ (i.e., parts per thousand) enrichment or depletion in the heavier isotope, ^{34}S, relative to standard sulfur from the Cañon Diablo meteorite. A ratio of $^{32}S/^{34}S = 22.22$ has been accepted internationally for Cañon Diablo sulfur. (LK)

29058 TEMPERATURE-SENSITIVE MATERIALS EXCHANGER. (to Deuterium Corp.). Netherlands Patent 7,204,320. 30 Mar 1972. 19p. (In Dutch).

Improvements are provided on an existing system for the enrichment of deuterium. In particular the last two steps in a heavy water production process are concerned, viz. the exchange of hydrogen sulphide at two different temperatures and the finishing of the product. (NL)

29059 INSTALLATION FOR EXCHANGING OF MATERIALS AT TWO DIFFERENT TEMPERATURES. (to Deuterium Corp.). Netherlands Patent 7,204,318. 30 Mar 1972. 41p. (In Dutch).

The invention provides an installation for exchanging materials at two different temperatures. At different temperatures the desired material is exchanged for another material in two fluids that are chemically different and light and heavy in relation to each other. Both fluids may contain each of the mentioned materials and can be separated from each other by physical means. The exchange yield is improved if there is an abundant supply of fluid. (NL)

29060 CONDENSOR AND SEPARATOR FOR EFFLUENTS AND AFFLUENTS. (to Deuterium Corp.). Netherlands Patent 7,204,319. 30 Mar 1972. 12p. (In Dutch).

An improved system is provided for the treatment of the supply and removal of matter. This system can be used well together with a system for exchanging a material at two different temperatures. An external watersource and a gas partly dissolved in water are used as the two process fluids. (NL)

29061 EQUILIBRIUM CONSTANTS OF HYDROGEN-DEUTERIUM-TRITIUM SELF-EXCHANGE REACTIONS IN WATER VAPOR AS STUDIED WITH A PULSED MOLECULAR-BEAM QUADRUPOLE MASS FILTER. Pyper, J.W.; Christensen, L.D. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Chem. Phys. 62: No. 7, 2596-2599 (1 Apr 1975).

We measured the equilibrium constants $K_{HDO} = P_{HDO}^2/P_{H_2O} \cdot P_{D_2O}$, $K_{HTO} = P_{HTO}^2/P_{H_2O} \cdot P_{T_2O}$, and $K_{DTO} = P_{DTO}^2/P_{D_2O} \cdot P_{T_2O}$ at 295.6°K (22.4°C), assuming the mass spectrometric sensitivities of the three species cancel in each expression of the equilibrium constant. The results obtained were $K_{HDO} = 3.82 \pm 0.05$, $K_{HTO} = 3.66 \pm 0.06$, and $K_{DTO} = 3.99 \pm 0.07$. These values agreed with the current theoretical values of $K_{HDO} = 3.84$, $K_{HTO} = 3.69$, and $K_{DTO} = 3.97$ at the same temperature. We discuss the discrepancy of the present value of K_{HDO} as compared with previous experimental determinations, and we conclude that a direct measurement of the mass spectrometric sensitivity ratio for K_{HDO} is still necessary to resolve the disagreement. We prepared the water mixtures that contained tritium by reacting the appropriate hydrogenic gases with oxygen over a platinum sponge catalyst. (auth)

29062 NITRIC OXIDE/NITROGEN ISOTOPE EXCHANGE ON TUNGSTEN. Gasser, R. P. H.; Jackson, G. V. (Oxford Univ.). J. Chem. Soc., Faraday Trans., I; 71: No. 2, 233-237 (1975).

The formation of $^{14}N^{15}N$ from a mixture of NO and $^{15}N^{15}N$ in the presence of a tungsten filament is measurable only at filament temperatures in excess of 1600°K, some 700°K above the temperature at which a mixture of $^{14}N^{14}N$ and $^{15}N^{15}N$ reacts to give $^{14}N^{15}N$. The temperature difference is attributed to the inhibiting effect of adsorbed oxygen derived from the NO. At the highest filament temperatures (>1800K) most (>80%) of the NO is decomposed. Under these conditions the rate of production of $^{14}N^{15}N$ is greater than the rate calculated from the measured partial pressures of $^{14}N^{14}N$ (produced by the decomposition of NO) and of $^{15}N^{15}N$, using the known efficiency of the filament as a nitrogen-isotope equilibrium catalyst. This effect may be due to an enhanced surface concentration of ^{14}N atoms resulting from the dissociative adsorption of NO. An order-of-magnitude calculation of the sticking probability of NO needed to account for the observations is in agreement with the value deduced from measurements of the rate of decomposition of NO by the hot filament. (auth)

29063 ISOTOPE EFFECTS IN LITHIUM IONS IN ELECTROMIGRATION IN AQUEOUS SOLUTIONS. Imai, M. (Tokyo Metropolitan Isotope Research Center). J. Inorg. Nucl. Chem.; 37: No. 1, 123-126(Jan 1975).

A new technique is presented for the enrichment of isotopes by electromigration in aqueous solution. A mechanism for isotope enrichment of lithium ions in aqueous lithium hydroxide solution is suggested. Preliminary experiments were performed to separate lithium ions in aqueous lithium hydroxide solutions. The separation factor increased with the concentration of lithium hydroxide more than expected. A mechanism of isotope effect involving ionic hydration is discussed. (auth)

29064 USE OF THERMOCHROMATOGRAPHY FOR RAPID CHEMICAL SEPARATIONS. P. 1. Application to Steady State Separation of Fission Product Isobars Obtained with an Isotope Separator On-Line a Reactor. Grapengiesser, B.; Rudstam, G. (Swedish Research Councils' Lab., Nykoeping). Radiochim. Acta; 20: No. 1/2, 85-90(1973).

In ISOL-systems many elements may be processed simultaneously through the isotope separator. The samples will then, as a rule, contain several isobaric components, which call for a chemical separation step. By using thermochromatographic techniques an apparatus has been constructed and attached to the collector side of the OSIRIS-facility. The apparatus permits a very rapid chemical separation to be carried out. Thus, halogen isotopes with half-lives of the order of 1-2 seconds have been successfully purified from accompanying isobaric contamination. (auth)

29065 ISOTOPIC REDISTRIBUTION IN THE NITROGEN OXIDE DECOMPOSITION BY AN ALTERNATING ELECTRIC FIELD. Lacoste, G.; Olive, H.; Routie, R. (Institut du Genie Chimique, 31 - Toulouse Empalot (France)). Compt. Rend., Ser. C; 279: No. 6, 257-258(5 Aug 1974). (In French).

The decomposition of nitrogen oxides into molecular oxygen and nitrogen in an alternating electric field shows, in the case of nitrogen dioxide alone, a variation with time of the isotopic contents of the reactions products. (FR)

29066 ISOTOPIC SEPARATION OF MERCURY BY INDIRECT PHOTOCHEMISTRY. Botter, F.; Scaringella, M.; Wacongne, M. (to CEA, 75 - Paris (France)). French Patent 2,204,445/A/. 26 Oct 1972. 13p. (In French).

A method is described for separating the isotopes of mercury by indirect photochemistry and, in particular, to the separation of isotope 196. The method consists in causing a gaseous stream of oxygen and butadiene containing a mixture of mercury isotopes to flow through one or several serially mounted vessels, and irradiating the gaseous stream by means of a vapor lamp con-

taining mercury with a low content of one or several isotopes. Mercury enriched by from 5 to 10% Hg is obtained, which is suitable for manufacturing isotope 197 wanted by physicians in view of its applications, in particular as an emitting source for the detection of tumors and in brain and spleen scintigraphy. (FR)

29067 FLASH DESORPTION OF HYDROGEN AND ETHYLENE AND EQUILIBRATION OF HYDROGEN AND DEUTERIUM ON PLATINUM SINGLE CRYSTAL SURFACES. Lu, K. E. C. Ithaca, NY; Cornell Univ. (1974). 133p. University Microfilms Order No. 75-6738.

Thesis (Ph. D.).

The adsorption and flash desorption of hydrogen and ethylene and the equilibration of H_2 and D_2 has been studied on the (110), (211), (111) and (100) planes of platinum. Hydrogen desorption from Pt(211), a stepped surface composed of (111) and (100) ledges, yields a desorption spectrum which apparently is a composite of desorption from the individual ledges. Pt(110) is quite similar to the tungsten structural analogy, W(211), in that both yield two-peak desorption spectra, and on both planes adsorption kinetics are dramatically different for filling of the two states. These multiple states of hydrogen on Pt(110) can be explained in terms of site-heterogeneity. Hydrogen desorption spectrum from Pt(111) yields a single peak with activation energy of 17.5 Kcal/mole for desorption. Hydrogen desorption from Pt(100) yields a complex 5 peak desorption spectrum. Complete exchange of hydrogen isotopes was observed for all of the states of all four planes suggesting dissociative adsorption. Adsorption kinetics are proportional to a single form, $(1-\theta)^2$ on all four planes, and estimates of the sticking probabilities show them to decrease in the order: [(110) > (211) > (100) > (111)]. Equilibration activity follows approximately the same order [(110) > (211) > (111) > (100)] with a factor of ~5 difference between the most and least active planes; no unusual activity is observed for the stepped surface, Pt(211). Below ~570°K equilibration of H_2 and D_2 is activated by less than 2 Kcal/mole with the magnitude dependent on the specific face, and above this temperature the reaction is non-activated. The non-activated region is apparently limited by the rate of adsorption and the statistics of mixing on the surface. Calculated rates of HD production per cm^2 based on this model are in excellent agreement with the experimental values for Pt(110) and Pt(211), and in somewhat poorer agreement for Pt(111) and Pt(100). Preliminary flash decomposition data for ethylene on platinum shows hydrogen to be the primary gas phase product. Along with this small amounts of ethylene and ethane are also detected. The hydrogen spectrum resulting from ethylene decomposition gives two equal peaks at ~300°K and ~520°K for the (111) plane, three peaks at ~330°K, ~420°K and ~520°K with a ratio of approximately 2 : 1 : 1 for Pt(110), and a single peak at ~365°K for the (100) plane. The hydrogen spectrum resulting from acetylene decomposition gives a single peak on Pt(111) corresponding to the ethylene peak at 520°K, a single peak Pt(110) corresponding to the ethylene peak at 520°K, and four peaks on the (100) plane. The correspondence between H_2 peaks from decomposition of both acetylene and ethylene suggests that a two-step decomposition process is at least partially operative in the decomposition of ethylene on platinum. (Diss. Abstr. Int., B)

29068 DISPLACEMENT CHROMATOGRAPHIC METHOD FOR SEPARATING URANIUM ISOTOPES. James, D. B. (to Atlantic Richfield Co.). US Patent 3,869,536. 4 Mar 1975. Filed date 12 Nov 1970. 12p.

A salient part of the disclosure describes a method for separating ^{235}U isotope from ^{238}U isotope comprising introducing a solution containing a reducing cation such as Ti^{+3} into a cation-exchange resin column, thereafter introducing a uranyl solution containing both ^{235}U and ^{238}U isotopes, followed by introduction of a solution containing an oxidizing agent such as Fe^{+3} and thereafter separately recovering uranyl solutions containing uranium which is enriched in ^{235}U isotope and uranium which is correspondingly depleted in ^{235}U isotope. (Official Gazette)

29069 NEW REACTION OF TRITHIOORTHACETATES. Reaction with Acylating Reagents. Hojo, M.; Masuda, R. (Kobe Univ., Japan). J. Org. Chem.; 40: No. 7, 963-965(4 Apr 1975).

The trifluoroacetylation of aryl trithioorthoacetates was experimentally studied and the physical properties and analytical data for the acylation products are tabulated. In deuterium exchange studies the deuterated product could be obtained almost quantitatively by evaporation of the solvent. (JSR)

29070 QUANTUM-MECHANICAL CALCULATION OF ISOTOPIC AND ORTHO-PARA SEPARATION COEFFICIENTS FOR THE CASE OF LOW-TEMPERATURE SORPTION OF HYDROGEN ISOTOPIC MOLECULES BY THE ZEOLITE Na A. Parbuzin, V. S.; Malyavskii, N. I. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 220: No. 1, 150-152(1 Jan 1975). (In Russian).

A quantum mechanical approach is proposed for the description of the separation of isotopic and spin-isomeric molecules of hydrogen during sorption with consideration of the dimensions and structure of the sorbent cell and of the contour of the potential energy of the sorbed molecule. The separation coefficient was calculated for the systems $o\text{-}H_2 - o\text{-}D_2$, $p\text{-}H_2 - p\text{-}D_2$, and $o\text{-}H_2 - HD$ and the results were compared with experimental data. The agreement was good except for the temperature region from 160 to 220°K. (JSR)

Feed Materials Processing

29071 (USBM-RR-62.1) METALLURGICAL AMENABILITY TESTS OF IDAHO–MONTANA THORIUM ORES. Ross, J. R.; George, D. R. (Bureau of Mines, Salt Lake City, Utah (USA). Salt Lake City Metallurgy Research Center). Nov 1966. 35p. GJO.

Amenability tests on 17 samples of thorium ore from Idaho and Montana were performed to investigate the recovery of thorium and rare earth elements by a process involving acid leaching and solvent extraction. The test work showed that 87 to 98 percent of the thorium can be extracted from the individual ores by leaching at 90° C for 6 to 20 hours with sufficient sulfuric acid to give a terminal pH of 0 to 0.5. Depending on the lime content of the samples, this requires acid additions of 300 to 1,300 pounds per ton. It is probable, however, that acid consumption could be reduced approximately one-third by employing countercurrent leaching techniques. Acid consumption can also be lowered by selective flotation of carbonates prior to leaching, but only at the expense of reduced thorium recovery. The rare earths are not appreciably solubilized by a simple hot acid leach but for most of the samples 50 to 80 percent of the rare earths can be solubilized by curing or baking the ores for 20 hours at 200° C with concentrated acid prior to leaching. Acid consumption is increased by 100 to 300 pounds per ton when this technique is used. The residues from acid leaching settle rapidly and would be readily amenable to washing by countercurrent decantation. Indicated thickener area requirements are of the order of 1 to 2 square feet per ton of residue per 24 hours. Testing established that thorium can be recovered as the oxide containing in excess of 99 percent ThO_2 by solvent extraction with a primary amine dissolved in kerosine followed by stripping with ammonium carbonate solutions. Most of the ammonia needed for the production of ammonium carbonate can be recovered by steam distillation and theoretically the only makeup chemical required would be a small amount of carbon dioxide and lime. A few cursory studies of the recovery of rare earths from the leach solutions showed that yttrium can be extracted with di-2-ethylhexylphosphoric acid following extraction of thorium with a primary amine. The other rare earths are not appreciably extracted. (auth)

29072 URANIUM HYDROMETALLURGY PROSPECTS. Boutonnet, G. Nucl. Eng. Int.; 20: No. 225, 100-102(Feb 1975).

A brief survey is made of the methods and merits of existing processes for extraction of uranium concentrates from ores, i.e., the "calcium" or two stage process, the concentrated H_2SO_4 process, the ammonium bisulfate process and the method of resin-in-pulp extraction. In considering the processing of the concentrate, two processes are described which show that it is industrially possible to obtain on the mine site, UF_4 with the requisite characteristics for fluorination to UF_6. (UK)

29073 URANIUM RECOVERY FROM SWEDISH LOW GRADE BITUMINOUS SHALES. Andersson, A.; Olsson, G. (Aktiebolaget Atomenergi, Stockholm). Nucl. Eng. Int.; 20: No. 225, 103-105 (Feb 1975).

There is every indication that the lower grade uranium ores of the world will become increasingly important in the 1980's both for continued operation of thermal reactors and for the more efficient fast breeder reactors. In this case Sweden will have the potential to become a large scale producer of uranium. An early initiative with the Ranstad pilot scale mine and processing plant has furnished valuable information about the technique and processes required to extract the uranium from the bituminous shales. A feasibility study for a full-scale operation, which would meet the needs of the 11 nuclear power plants currently operating or under construction in Sweden has been completed and is described. (auth)

Radiation Chemistry

Refer also to abstracts 28999, 29049, 29136, 29781, 29790, 29793, 29803, 29831, 29833, 30155, and 30296.

29074 (AD/A-000191) MIGRATION OF RADICAL STATES IN CRYSTALLINE DIMETHYLGLYOXIME. Yakimchenko, O. E.;

Lebedev, Ya. S. 9 Oct 1974. Translated by F. C. Vaughn from pp 212-220 of Problem Kinetiki i Kataliza. IV. Mekhanizm i Kinetika Geterogennykh Reaktsii, Moscow, 1973. (FTD-MT-24-1771-74). 20p. NTIS $3.25.

Elementary reactions of the valence migration in single crystals of dimethylglyoxime (DMG) gamma-irradiated at 77°K and deuterated dimethylglyoxime-0,0-D2 (DMG-0,0-D2) were studied using EPR spectra of radical pairs over a wide range of temperatures. Values of the elementary rate constants and the magnitudes of kinetic isotopic effects were obtained. It has been shown, that at low temperatures fast reactions of the valence migration of Type I can proceed by means of the intro- and intermolecular transfer of hydrogen. The values of the rate constants and isotopic kinetic effects of low-temperature reactions are indicative of the significant role of the tunnel mechanism in the transfer of the hydrogen atom. (GRA)

29075 (AGC-0716-19(01)SP) EXPLOSIONS IN PILE-IRRADIATED LIQUID NITROGEN. Owe Berg, T. G. (Aerojet-General Corp., Downey, Calif. (USA)). 24 Sep 1963. 71p. Dep. NTIS $6.75.

The literature on explosions in pile-irradiated liquid nitrogen and in liquid oxygen-ozone mixtures and on related phenomena is reviewed. The probable reactions and reaction mechanisms are discussed. The information available in the literature is insufficient for definitive conclusions, but some indications may be deduced. It appears that nitrogen oxides are formed from the oxygen contained in the nitrogen as an impurity, and that explosion of these is initiated by the ambient, when it is admitted into the system after the liquid nitrogen has evaporated during warm-up. Consequently, the explosion hazard may be reduced by using high-purity nitrogen in small quantities and by preventing the ambient from entering the system. The hazard cannot be completely eliminated unless the formation of the explosion product is suppressed by means of some inhibitor to be determined by experiment. (auth)

29076 (APIA-T-09-03-003) INFLUENCE OF IRRADIATION ON THE CHEMICAL COMPOSITION OF FOODS. Massa, M. H. L. M.; Costa, M. H. L. M.; da Rosa Rodrigues, H.; Fagundes, C. C. L. (Administracao do Programa de Irradiacao de Alimentos, Rio de Janeiro (Brazil)). 1973. 35p. (In Portuguese). INIS.

Possible effects of irradiation on the composition of rice and flour were studied, with the objective of verifying immediate alterations caused by irradiation with low doses. A series of polished rice (non-irradiated, irradiated with 10 krad, and irradiated with 50 krad) was used. This series was reanalyzed at 4-month intervals for a year; another series of three samples of an unpolished milled rice (non-irradiated, irradiated with 10 krad, and irradiated with 20 krad) was reanalyzed at 2-month intervals for 10 months. Flour, irradiated with doses of 5, 10, and 50 krad, was reanalyzed twice at 2-month intervals. A fourth series of flour samples was reanalyzed three times at 2-month intervals. The contents in ashes, carbohydrates, reducing and non-reducing sugars, acidity, ether extract, and crude protein revealed no variation with the dose used. The only modification was the water content. In polished rice, the content decreased as the dose was increased and during storage until the polished layer was destroyed; then the content began to increase. The non-irradiated sample maintained the highest content. With unpolished milled rice the water content increased with time. The sample irradiated with the 20 krad dose absorbed the lowest percentage of water with aging. The content of humidity in flour decreased with increase of the dose; after two months, the non-irradiated and irradiated samples tend to reach the same water content. In all cases, the irradiated samples displayed an external aspect superior to that of the corresponding non-irradiated samples. (INIS)

29077 (CEA-CONF-2718) LATEX VULCANIZATION BY IRRADIATION. Laizier, J.; Veber, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). [nd]. 24p. (In French). (CONF-740690-1). Dep. NTIS (US Sales Only) $4.25.

From 4th European conference of plastics and rubbers; Paris, France (4 Jun 1974).

A procedure for the production of latex prevulcanized by irradiation was developed for natural rubber latex. Either electron beams or γ irradiation can be used as the nature of the irradiation does not affect the characteristics of the latex or the rubber. The mechanical properties of the irradiated latex are a function of the irradiation dose. The addition of various additives reduces the dose needed for the prevulcanization. The homogeneity of the dose is quite important because of its effect on the remanence. The presence of oxygen has little effect on the evolution of the rupture resistance. The aging characteristics are improved if the irradiation is carried out at a temperature somewhat above room temperature. The irradiation of synthetic latex does not lead to satisfactory results. The mechanisms occurring during the radioreticulation are discussed. The mechanical stability, chemical stability, and viscosity of the prevulcanized latex are reported. (JSR)

29078 (CEA-CONF-2879) NMR AND ESR STUDIES OF THE SOLID-STATE POLYMERIZATION OF METHACRYLIC ACID. Chachaty, C.; Latimier, M.; Forchioni, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Chimie-Physique). 1973. 22p. (CONF-740715-23). Dep. NTIS (US Sales Only) $4.25.

From 5th international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

The kinetics of post-polymerization of γ-irradiated methacrylic acid at 77°K has been investigated by wide line NMR and by ESR spectroscopy. The conversion yield was continuously measured in the temperature range of 260°K to 280°K, from the narrowing of the NMR spectrum due to the progressive "amorphization" of the matrix, releasing the motion of monomer molecules. The rate of post polymerization decays exponentially with time, independently of the recombination of free radicals. The local concentration of radicals subsisting after prolonged annealing remains actually the same as the initial one, showing that no recombination occurs in the microdomains of polymerization. The ^{13}C NMR study of the polymethacrylic acid formed by solid state polymerization shows a predominant syndiotactic character, with an increasing contribution of isotactic sequences as the post-polymerization temperature is lowered. (auth)

29079 (FZK-219) INVESTIGATION OF EXPLOSIONS IN IRRADIATED LIQUID-NITROGEN DEWARS. Romanko, J. (General Dynamics/Fort Worth, Tex. (USA)). 15 Dec 1964. 126p. Dep. NTIS $9.50.

The studies reported were undertaken to investigate the phenomena occurring before, during, and after explosions involving irradiated dewars of liquid nitrogen with various amounts of impurities, including oxygen, water vapor from the ambient air, and solid "catalysts", in an effort to provide an understanding of the cause of explosions in cryogen test vessels used in nuclear reactor experiments conducted at various laboratories in this country and abroad. The program was divided into two major parts which were run concurrently. The first part of the program was concerned with experimental studies of an engineering or technological nature to produce explosions under controlled conditions in specially designed open and closed dewars outfitted with various diagnostic instruments and to identify the conditions under which the explosions occur. The second part of the program involved fundamental experimental studies in the laboratory, using spectrometric instruments, of the basic phenomena occurring therein to provide an understanding of the fundamental processes that lead to the explosions. (LK)

29080 (FZK-351-2) NERVA IRRADIATION PROGRAM, GTR Test 21, Volume II. Nuclear-Radiation-Induced Conversion of Parahydrogen to Orthohydrogen. Nelms, L. W.; Carter, H. G. (General Dynamics/Fort Worth, Tex. (USA)). 15 May 1968. 156p. Dep. NTIS $11.00.

A model for conversion is postulated that assumes that certain products formed in liquid parahydrogen during irradiation ultimately cause conversion in the gas. To test the model, samples of liquid parahydrogen (up to 15 gal/sample) were irradiated by the Ground Test Reactor (GTR). A double-vessel dewar in which the sample hydrogen contained in the inner vessel could be totally immersed in LH_2 contained in the outer vessel was constructed for the irradiation. Gas was continuously bled from the active-volume effluent during irradiation and piped to a para-orthohydrogen analyzer. The orthohydrogen content of the effluent was measured by means of a continuous flow gas analyzer of the thermal-conductivity type. Irradiation data were obtained for gammas from 1.7×10^8 to 1.2×10^9 ergs/g(C)-h and neutrons from 2.2×10^{14} to 1.6×10^{15} n/cm^2-h (E > 1.0 MeV). Large amounts of conversion were observed, the highest reported being reduction of 99% p-H_2 to 38% p-H_2 (≈ 49% relative conversion). Two experimental runs were compared with calculations. A quantitative description of the model was formulated, and calculations were made of the conversion of parahydrogen to orthohydrogen for these two runs. Order-of-magnitude agreement was obtained between the calculations and the experimental data, and agreement between the calculated and observed effects of both boiloff rate and reactor power was also reasonably good. (DLC)

29081 (TID/SNA-836) EXPLOSIONS IN PILE-IRRADIATED LIQUID NITROGEN. Owe Berg, T. G. (Aerojet-General Corp., Azusa, Calif. (USA)). 24 Sep 1963. 71p. Dep. NTIS $6.75.

The literature on explosions in pile-irradiated liquid nitrogen

and in liquid oxygen-ozone mixtures and on related phenomena is reviewed. The probable reactions and reaction mechanisms are discussed. The information available in the literature is insufficient for definitive conclusions, but some indications may be deduced. It appears that nitrogen oxides are formed from the oxygen contained in the nitrogen as an impurity, and that explosion of these is initiated by the ambient, when it is admitted into the system after the liquid nitrogen has evaporated during warm-up. Consequently, the explosion hazard may be reduced by using high-purity nitrogen in small quantities and by preventing the ambient from entering the system. The hazard cannot be completely eliminated unless the formation of the explosion product is suppressed by means of some inhibitor to be determined by experiment. (auth)

29082 RADIATION-SENSITIZED THERMAL CRACKING OF n-BUTANE. II. Ionic Reactions. Matsuoka, S. (Furukawa Electric Co., Tokyo); Tamura, T.; Oshima, K.; Oshima, Y. Can. J. Chem.; 53: No. 1, 92-97(1 Jan 1975).

Ionic reactions in the radiolysis of n-butane were studied at temperatures ranging from 17 to 548°C. Ionic chain reactions were found for the first time to take part in the radiation-sensitized thermal cracking mechanism of hydrocarbon system. The isobutane and isobutene yields increased with increasing temperature and at 548°C their G-values reached 31.2 and 12.1, respectively, though they were not formed by the thermal cracking of n-butane. The formation was completely suppressed by the addition of 0.15 mol % ammonia. They were produced with high yields irrespective of the kind of wall of the irradiation cells. It was concluded from these results that isobutane and isobutene were formed by homogeneous ionic chain reactions with activation energies. Part of the propane product was also found to have been formed by ionic chain reactions. From the effect of adding n-pentane on the yields of the ionic products, $C_4H_9^+$ ion was inferred as the carrier ion. In the vicinity of room temperature, formation by ionic reactions of polymers with more than 14 carbon atoms was inferred from the material balance of the products from H_2 to C_{14}. (auth)

29083 RADIATION–CHEMICAL SCAVENGER INVESTIGATION OF 1,1,2-TRIFLUORO-1,2,2-TRICHLOROETHANE. Proesch, U.; Uckert, W.; Kolditz, L. (Humboldt-Universitaet, Berlin). Isotopenpraxis; 11: No. 2, 63-65(Feb 1975). (In German).

The use of iodine as a scavenger in F-113 (1,1,2-trifluoro-1,2,2-trichloroethane) is reported. The conversion concentration diagrams is presented. The radiation-induced polymerization of methyl methacrylate in F-113 has been measured for further radiation-chemical characterization of the solvent. With dose rate ranging 302 rd/min, polymerization is inhomogeneous within the larger portion of the range of miscibility. (auth)

29084 COPOLYMERIZATION OF THE FLUOROANHYDRIDE OF PERFLUOROMETHACRYLIC ACID WITH TRIFLUOROCHLOROETHYLENE UNDER THE EFFECTS OF γ RADIATION. Mukhamadaliev, N.; Yul'chibaev, A. A.; Agzamova, R. T.; Usmanov, Kh. U. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 18: No. 1, 109-111(1975). (In Russian).

Copolymerization of the fluoroanhydride of fluoromethacrylic acid with trifluorochloroethylene under the effects of γ radiation was studied for different dose rates and total doses. The copolymerization constants were determined. Trifluorochloroethylene is the more active monomer in the system. The solubility, thermomechanical properties, and thermal stability of the copolymer obtained were studied. It was shown that with increase of the contents of trifluorochloroethylene in the copolymer its thermal stability and heat resistance increases. (tr-auth)

29085 ELECTRON PARAMAGNETIC RESONANCE INVESTIGATION OF NO_3, NO_3^{2-}, AND O_2^- IN IRRADIATED NH_4NO_3. Jarke, F.H.; Ashford, N.A. (IIT Research Institute, Chicago, Illinois 60616). J. Chem. Phys. 62: No. 7, 2923-2924 (1 Apr 1975).

The ESR spectrum of NH_4NO_3 after γ irradiation at 77°K is reported. Resonances assigned to NO_3^{2-}, NO_3, and O_2^- were observed. No NH_4 related radicals were found. (AIP)

29086 ESR STUDIES OF $[RhCl_6]^{4-}$ IN VARIOUS MATRICES. Shock, J.R.; Rogers, M.T. (Department of Chemistry, Michigan State University, East Lansing, Michigan 48824). J. Chem. Phys. 62: No. 7, 2640-2645 (1 Apr 1975).

An ESR study of the $[RhCl_6]^{4-}$ center in single crystals of AgCl has been made. The g values and chlorine hyperfine interactions observed for the axial chlorines are consistent with a d^7 configuration and localization of the odd electron largely in the $4d_{z^2}$ orbital. The same species has been studied in γ-irradiated single crystals of NaCl doped with $[RhCl_6]^{3-}$ and the ESR parameters found were quite similar. Polycrystalline $Na_3RhCl_6 \cdot 12H_2O$, after γ irradiation at room temperature, appears to give the same species, although only $g_\perp$ can be obtained from the spectrum. Molecular orbital theory has been used to interpret the chlorine hyperfine interactions in terms of bonding parameters for the complex. The delocalization found is smaller than that for $[RhBr_6]^{4-}$. (auth)

29087 PARAMAGNETIC HEXAFLUORIDE ANIONS OF GROUP VI. Morton, J.R.; Preston, K.F.; Tait, J.C. (Division of Chemistry, National Research Council of Canada, Ottawa, Canada). J. Chem. Phys. 62: No. 6, 2029-2030 (15 Mar 1975).

Certain isotropic ESR spectra observed in γ–irradiated SF_6 and in γ–irradiated solid solutions of SeF_6 and TeF_6 in SF_6 are attributed to the hexafluoride anions of the Group VI elements. Hyperfine interaction measurements for the species $^{33}SF_6^-$, $^{77}SeF_6^-$, and $^{125}TeF_6^-$, observed in natural abundance, show that the central atom outer s orbital makes a very large contribution to the (totally symmetric) semioccupied orbital in these radicals. INDO MO calculations for SF_6^- gratifyingly predict a half–filled orbital which has the representation A_{1g} in O_h symmetry and which is primarily composed of S 3s and F 2p_σ atomic orbitals. An additional isotropic spectrum present in γ–irradiated 1% SeF_6 in SF_6 is believed to be that of SeF_5 in which hyperfine interaction with the unique (apical) F nucleus is not detectable. (auth)

29088 ON THE TWO STATE MODEL FOR ELECTRONS IN NONPOLAR LIQUID HYDROCARBONS. Tachiya, M.; Mozumder, A. (Radiation Laboratory, and the Department of Chemistry, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 62: No. 6, 2125-2129 (15 Mar 1975).

Assuming that electrons are partially free and partially trapped in nonpolar liquid hydrocarbons, we have treated theoretically the scavenging and neutralization processes in these systems. The square root law in scavenging at low cencentrations and the $t^{-1/2}$ law in the decay of the survival probability at long times which are experimentally observed and theoretically derived for the one state model, can also be derived for the two state model in these respective limits. However, the Laplace transform relation between the probability of scavenging and that of survival against neutralization, which obtains for the one state model, is no longer strictly valid in the two state model. (auth)

29089 PROTON AND DEUTERON RADIOLYSIS OF ARGON MATRIX SAMPLES OF O_2 AND Cl_2. INFRARED SPECTRA OF CHARGED SPECIES. Andrews, L.; Ault, B.S.; Grzybowski, J.M.; Allen, R.O. (Chemistry Department, University of Virginia, Charlottesville, Virginia 22901). J. Chem. Phys. 62: No. 6, 2461-2464 (15 Mar 1975).

Argon matrix samples containing O_2 and Cl_2 have been bombarded with 2.0 keV protons and deuterons during condensation at 15°K. In the oxygen experiments, bands due to O_3 and HO_2 appeared. Of most interest is isolated O^-_3 at 804.3 cm^{-1}. Deuteron radiolysis produced increased yields of the 644 cm^{-1} band which is confirmed as a DAr^+_n species. Proton and deuteron radiolysis of chlorine–containing samples produced HCl_2^- and DCl_2^- in high yields. Owing to the strong electron scavenging capability of chlorine, these species are probably anions. (auth)

29090 PULSE RADIOLYSIS STUDIES OF TIME DEPENDENT SPECTRAL SHIFTS OF THE SOLVATED ELECTRON IN ETHANOL AND DEUTERATED ETHANOL GLASSES AT 76 K. Klassen, N.V.; Gillis, H.A.; Teather, G.G. (Division of Physics, National Research Council of Canada, Ottawa, Canada K1A 0R6); Kevan, L. J. Chem. Phys. 62: No. 6, 2474-2476 (15 Mar 1975).

The initial (≤200 nsec) spectra of the trapped electron are similar in C_2H_5OH, C_2H_5OD, C_2D_5OH, and C_2D_5OD glasses at 76 K with λ_{max} ~1300 nm. The kinetics of the spectral shifts to the stable values of λ_{max} near 540 nm are similar for C_2H_5OH and C_2H_5OD and resemble the kinetics of a series of first order processes or of tunneling reactions. Structure seems to be present in the partially relaxed spectra and may result from specific geoemetrical orientations of first solvation shell molecules. (auth)

29091 PULSE RADIOLYSIS STUDIES OF AROMATIC LIQUIDS. I. Electrons and Negative Ions. Robinson, A. J.; Rodgers, M. A. J. (Univ. of Manchester, Eng.). J. Chem. Soc., Faraday Trans., I; 71: No. 2, 378-388(1975).

Pulse radiolysis studies of the aromatic liquids benzene, toluene and o-xylene have been carried out using a time-resolved conductivity detection technique. The observed transient ion currents are consistent with the immediate formation of highly mobile electrons together with slowly moving cations. The electrons decay either by ion recombination, or by reaction with residual impurity or added solutes. Rate constants for electron-solute interactions have been measured, as have G-values of electrons which escape the coulombic field of the parent ion. The effect of high concentrations of electron scavengers have been interpreted in terms of capture of epithermal electrons. (auth)

29092 RADICAL PAIRS IN γ-IRRADIATED POLYMERS DETECTED BY E.S.R. Hesse, P.; Heusinger, H. (Univ., Munich). Int. J. Radiat. Phys. Chem.; 7: No. 1, 1-6(Feb 1975).

The ESR signal due to the $\Delta m = 2$ transition of radical pairs was observed in a number of γ-irradiated polymers (polyacrylates, diene polymers, polystyrene and polypropylene sulfide). The distance and concentration of paired radicals were calculated from the position and the intensity of the $\Delta m - 2$ signal. In all polymers investigated, about 2% of the radicals were arranged in pairs, the distance being 5 to 6Å. It is concluded that there is no direct connection between the presence of radical pairs and cross-linking or chain scission. (auth)

29093 ELECTRON SCAVENGING BY N_2O IN THE RADIOLYSIS OF LIQUID HYDROCARBONS. Hatano, Y.; Ito, K.; Takao, S. (Tokyo Inst. of Tech.). Int. J. Radiat. Phys. Chem.; 7: No. 1, 39-45(Feb 1975).

The γ-radiolysis of liquid neopentane and 2,2,4-trimethylpentane has been studied in the presence of low concentrations of N_2O. The addition of N_2O to neopentane at the mole fraction $1 \times 10^{-6} \leq N_s \leq 1 \times 10^{-4}$ gives constant $G(N_2) = 1.1 \pm 0.1$ at 293 ± 1 K. At lower concentrations, $1 \times 10^{-7} \leq N_s \leq 1 \times 10^{-5}$, $G(N_2)$, calculated from the nitrogen formation vs dose, leads to the same value, in good agreement with the free-ion yield resulting from electrical conductivity. In 2,2,4-trimethylpentane, $G(N_2)$ decreases gradually with decreasing N_2O concentrations even for $1 \times 10^{-6} \leq N_s \leq 1 \times 10^{-4}$. However, for $1 \times 10^{-6} \leq N_s \leq 7 \times 10^{-6}$, $G(N_2)$ is found to be constant and equal to 0.33, which also agrees well with the free-ion yield. It may be concluded that $G(N_2)$ arises from the complete scavenging of the free electrons at $1 \times 10^{-7} \leq N_s \leq 1 \times 10^{-4}$ in neopentane, and at $1 \times 10^{-6} \leq N_s \leq 7 \times 10^{-6}$ in 2,2,4-trimethylpentane, and that, at such low concentrations of N_2O, one N_2 molecule is produced per electron scavenged by N_2O. Compared with the result obtained for cyclohexane and n-hexane containing N_2O, the present results may represent typical features of the electron scavenging process in the γ-radiolysis of liquid hydrocarbons at the lower concentrations of N_2O. (auth)

29094 PULSE RADIOLYSIS OF PYRROLIDINE (C_4H_8NH) IN AQUEOUS SOLUTION. Getoff, N. (Univ., Vienna); Schwoerer, F. Int. J. Radiat. Phys. Chem.; 7: No. 1, 47-49(Feb 1975).

The total absorption spectra of the short-lived species produced by the reaction of CH radicals with protonated (respectively unprotonated) pyrrolidine have been obtained. The characteristic data for the protonated intermediates are: $\lambda_{max} = 222.5$ nm $\epsilon_{222.5} = 90$ m^2 mol^{-1}, $2k = 0.52 \times 10^9$ dm^3 mol^{-1} s^{-1}; and for the unprotonated ones: $\lambda_{max} = 230$ nm, $\epsilon_{230} = 195$ m^2 mol^{-1}, $2k = 1.38 \times 10^9$ dm^3 mol^{-1} s^{-1}. For the equilibrium of both $pK_a = 10.5$ has been determined. (auth)

29095 DISTRIBUTION OVER ROTATIONAL AND VIBRATIONAL LEVELS OF EXCITED CH AND C_2 MOLECULES PRODUCED BY THE DISSOCIATION OF HYDROCARBONS BY ELECTRON IMPACT. Polyakova, G. N.; Fizgeer, B. M. (Kharkov State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 5, 329-332(1974).

Translated from Khim. Vys. Energ.; 8: No. 5, 387-391(1974).

A study was made of the distribution of CH molecules in the $A^2\Delta$ and $B^2\Sigma^-$ states, and of C_2 molecules in the $A^3\Pi_g$ state, over the rotational and vibrational energy levels. The CH and C_2 molecules were produced by the dissociation of C_2H_2, CH_4, C_2H_4, C_2H_6, and C_6H_6 on bombardment with 300 eV electrons. The distribution of CH molecules ($A^2\Delta$, $v' = 0, 1$) over the rotational energy levels was Boltzmann and corresponded to the same rotational temperature for all the hydrocarbons investigated. Boltzmann distributions were also found for CH ($B^2\Sigma^-$, $v' = 0$) over the rotational levels and $C_2(A^3\Pi_g)$ over the rotational and vibrational levels. In these cases also the distributions did not depend on the initial hydrocarbon. An explanation is suggested for the independence of the distributions of the fragment molecules over the rotational and vibrational levels on the type of hydrocarbon used. (auth)

29096 SPACE CHARGE BUILD-UP DURING THE UNIFORM IRRADIATION OF DIELECTRICS BY FAST ELECTRONS. Vorob'ev, A. A.; Gusel'nikov, V. N.; Evdokimov, O. B. (Tomsk Polytechnical Inst., USSR). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 5, 363-366(1974).

Translated from Khim. Vys. Energ.; 8: No. 5, 428-432(1974).

An experimental investigation was carried out on the build-up of a space charge (SC) in polymethylmethacrylate (PMMA) and polystyrene (PS) under conditions of uniform irradiation by fast electrons. The volume current density in the samples varied from $8 \cdot 10^{-3}$ to 0.63 A/m^3 in PMMA and from $8 \cdot 10^{-5}$ to 0.1 A/m^3 in PS. It was found that under these conditions the potential distribution within the sample is parabolic, while its time dependence in each plane during irradiation obeys a hyperbolic tangent law. From an analysis of the experimental results the dependence of various dielectric parameters on dose rate was obtained. (auth)

29097 SPATIAL DISTRIBUTION OF RADICALS IN POLYISOBUTYLENE EXPOSED TO GAMMA AND ALPHA RADIATIONS. Pasal'skii, B. K.; Lavrentovich, Ya. I.; Vonsyatskii, V. A.; Kabakchi, A. M. (Inst. of Physical Chemistry, Kiev). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 5, 382-385(1974).

Translated from Khim. Vys. Energ.; 8: No. 5, 451-454(1974).

The method of continuous saturation of the ESR signal was used to investigate the spatial distribution of radicals in polyisobutylene (PIB) irradiated at low temperatures with γ- and α-radiations. It was found that the relaxation parameters of the radicals depend both on their average concentration and on the type of radiation. For low absorbed doses of ^{60}Co γ-rays the calculated local concentration of radicals in spurs was $7.4 \cdot 10^{18}$ cm^{-3}, while the corresponding value for α-particle tracks was significantly higher at $\sim 5.1 \cdot 10^{19}$ cm^{-3}. The radius of an α-particle tract in PIB, calculated from the experimental data, was ~15–20 Å. Suggestions are made regarding the occurrence of primary processes in localized regions, spurs or charged particle tracks, in irradiated PIB. (auth)

29098 KINETICS OF THE THERMAL- AND RADIATION-CATALYTIC DECOMPOSITION OF NITROUS OXIDE ON γ-Al_2O_3. The Radiation-Catalytic Process. Glebov, D. V.; Kolbanovskii, Yu. A.; Chernysheva, A. S. (Inst. of Petrochemical Synthesis, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 5, 376-381(1974).

Translated from Khim. Vys. Energ.; 8: No. 5, 444-450(1974).

A study has been carried out of the kinetics of the radiation-catalytic decomposition of N_2O on γ-Al_2O_3 in the temperature range 660 to 790°K and atmospheric pressure, using a circulating-flow apparatus at a gas flow rate of ~40 cm^3 (NTP)/min. A dose of ~10^{17} eV/g was given at a constant dose rate of ~500 r/sec of ^{60}Co γ-rays. It was found that the catalyst is poisoned more quickly in the radiation process and on a previously irradiated surface than in the thermal process. The activation energy for N_2O decomposition on a given sample of γ-Al_2O_3 increases with the working time of the catalyst, finally reaching a value of 57 ± 5 kcal/mole. The results on the rate of poisoning of the catalyst during the radiation-catalytic decomposition of N_2O can be used to construct a mechanism for the true catalytic process and to determine its kinetic parameters. (auth)

29099 MECHANISM OF PARAMAGNETIC CENTER FORMATION IN THE γ-IRRADIATION OF ADDUCTS OF UREA WITH CARBOXYLIC ACID ESTERS AT –196°C. Koritskii, A. T.; Kuleshov, A. P.; Soroka, L. B.; Trofimov, V. I. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 5, 370-375(1974).

Translated from Khim. Vys. Energ.; 8: No. 5, 437-443(1974).

The ESR technique was used to investigate the paramagnetic centers in γ-irradiated inclusion compounds of carboxylic acid esters with urea at –196°C and the effects of subsequent warming or exposure to light. It was found that in the adducts of urea with esters having an odd number of C atoms in the acid radical (esters of valeric and pelargonic acids), trapped electrons and $R\dot{C}H_2$ alkyl radicals are formed; in adducts of esters in which the acid radicals have an even number of C atoms, $R\dot{C}H_2$ radicals and the anion radicals $R_1-\dot{C}\begin{smallmatrix}O^-\\OR^2\end{smallmatrix}$ (I) are formed. On exposure to visible light the trapped electrons disappear and the alkyl radical concentration increases. On exposure to UV light the anion-radicals are converted to $R\dot{C}H_2$ alkyl radicals and in part ionized. Raising the temperature of the irradiated samples converts anion-radical I to the radical $R_1-\dot{C}\begin{smallmatrix}OH\\OR_2\end{smallmatrix}$ (II), which is transformed to alkyl radical $R\dot{C}H_2(R_2)$ by UV light. It is proposed that in the adducts investigated trapped electrons, anion-radicals I and/or radicals II are precursors of alkyl radicals $R\dot{C}H_2$. (auth)

29100 STUDIES CONCERNING THE RING-OPENING-PRODUCTS FORMED BY RADIOLYSIS OF PERFLUOROMETHYLCYCLOHEXANE. Wiesboeck, R.; Proksch, E.; Gehringer, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Chemie; Technische Hochschule, Vienna (Austria). Inst. fuer Allgemeine Chemie). Z. Phys. Chem. (Frankfurt); 88: No. 1/4, 129-140(Jan 1974). (In German).

The "dimeric fraction" (products containing ^{14}C atoms) resulting from the radiolysis of perfluoromethylcyclohexane has been further split up into different fractions by preparative gas chromatography. These fractions have been analyzed by mass spectroscopy. It has been found that the C_{14}-products consist of 78% fluorocarbons with the summation formula $C_{14}F_{28}$. These are compounds with two rings of perfluorocyclohexane in one molecule. The remaining 22% are perfluorocarbons with the summation formula $C_{14}F_{28}$. These are substances with one intact and one opened ring of perfluorocyclohexane. G-values of 0.41 and 0.11 for the $C_{14}F_{28}$-isomers and the ring-opening-products

$C_{14}F_{28}$ respectively have been calculated from the known G-values of the sum of the dimeric products. Furthermore, another ring-opening product, perfluoroheptane, has been identified. A G-value of 0.14 has been found for this substance. (auth)

29101 IMPROVEMENTS IN THE METHODS FOR GRAFTING STYRENE ON POLYAMIDES AND IN THE GRAFTED PRODUCTS THUS OBTAINED. Chapiro, A.; N'Guyen Thy, T. H. (to Agence Nationale de Valorisation de la Recherche (ANVAR), 92 - Paris-Defense (France)). French Patent 2,192,134/A/. 7 Jul 1972. 8p. (In French).

Solid polyamide is brought into contact with a solution containing about 77% (by volume) styrene, 19% acetic acid and 4% water, and the whole is submitted to ionizing radiation, the intensity of which is lower than a critical threshold of about 100 rads per minute. The method can be applied to the preparation of fibers and hairs of grafted polyamide-polystyrene copolymer containing more than 50% polystyrene by weight, and therefore compatible with the polymer. (FR)

29102 A NOVEL METHOD FOR TREATING CELLULOSIC TEXTILE MATERIALS BY GRAFTING AND IRRADIATION, WITH A VIEW TO PROVIDING THEM WITH PERMANENT ANTI-CRUMPLE PROPERTIES. Wattiez, D.; Chatelin, R.; Fabre, P. (to Agence Nationale de Valorisation de la Recherche (ANVAR), 92 - Paris-Defense (France)). French Patent 2,204,734/A/. 27 Oct 1972. 19p. (In French).

A method for treating cellulosic textile materials by grafting and irradiation is described. The method consists of grafting of the cellulosic textile materials by means of an acrylic monomer of at least 6% (and preferably from 10 to 18%) with respect to the weight of the starting cellulosic material; irradiation treatment of the grafted cellulose material by an ionizing radiation, with a dose of up to 10M rads, preferably between 1 and 4 Mrads and, still better of 2 Mrads; a post-irradiation treatment by storage in the absence of oxygen, preferably in an atmosphere of nitrogen or other inert gas for a duration of up to 14 days and preferably of from 7 to 9 days; and a treatment for stabilizing the product obtained. (FR)

29103 MALEIMIDO-BENZOIC ESTERS, THEIR PREPARATION AND THEIR USE IN RADIO-SETTING COATING COMPOSITIONS. Mileo, J. C.; Sillion, B. (to Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison; CEA, 75 - Paris (France)). French Patent 2,206,317/A/. 16 Nov 1972. 14p. (In French).

Description is given of new compounds with unsaturated ester groups and of their preparation and uses, in particular in preparation of radiation-setting coating compositions. These compounds result from esterification or transesterification of a polyhydroxylated resin by a carboxylic compound selected from the group comprising the meta- and para-maleimido benzoic acids and their functional derivatives, and comprise at least two meta- or para-maleimido benzoate groups. In admixture with one or several unsaturated monomers and/or with one or several saturated or unsaturated polymers, they form copolymerizable compositions, in particular under the action of an ionizing radiation. (FR)

29104 ESR SPECTRA OF RADIATION INDUCED ANION RADICALS OF 1,3-BUTADIENE AND ITS DERIVATIVES IN 2-METHYLTETRAHYDROFURAN GLASS. Shiga, T. (Kyoto Univ. (Japan). Dept. of Polymer Chemistry); Lund, A. (Swedish Research Councils' Lab., Nykoeping). Ber. Bunsenges. Phys. Chem.; 78: No. 3, 259-265(Mar 1974).

A bleachable component in the ESR spectra of γ-irradiated MTHF glass containing 1,3-butadiene, isoprene, 2,3-dimethylbutadiene, 1,3-pentadiene and 2,4-hexadiene at 77°K is attributed to the molecular anions. The spectra were analyzed by a procedure that involves the computation of line profiles produced by anion radicals rigidly trapped in the matrix. The application of this technique to differentiate between possible conformations of the ions is discussed. (auth)

29105 A PAINT ADAPTED TO HARDEN THROUGH IRRADIATION AND ITS APPLICATIONS. Kinstle, J. F. (to Ford France, 75 - Paris). French Patent 2,202,139/A/. 5 Oct 1973. 12p. (In French).

The invention concerns a paint that can be reticulated at low irradiation doses. It contains mono-unsaturated monomers and a saturated prepolymer. Divinyl, trivinyl, and tetravinyl in solution with the prepolymer can be used. A solution of the prepolymer in vinyl monomer in the form of a paint layer is applied on a substrate and it is hardened by exposure to ionizing radiations, for example, an electron beam. (FR)

29106 γ-RADIOLYSIS OF STEARIC ACID: STUDIES OF NONGASEOUS PRODUCTS. Wu, G. S.; Howton, D. R. (Univ. of California, Los Angeles). Radiat. Res.; 61: No. 3, 374-392 (Mar 1975).

A number of products of ^{60}Co-γ-radiolysis of crystalline stearic acid were identified and quantitated by gas–liquid chromatography. n-Heptadecane, the major (decarboxylation) hydrocarbon product (G ca. 2.5 at 100 Mrads; G_0 3.6), is accompanied by n-hexadecane (G 0.033) and the C_{34} n-tetratriacontane (G 0.060) in amounts necessitating consideration of the formation of the C_{18} via α,β-bond fission, and of the C_{34} hydrocarbon from geminate pairs of heptadecyl radicals produced by double decarboxylation of the H-bonded stearic acid "dimers" of which the crystalline acid consists. Di-n-heptadecyl ketone (G 0.47), a product exceeded in quantitative importance only by those of dehydrogenation and decarboxylation reactions, is apparently formed by closely analogous, simultaneous formation of two radicals from such "dimers." The G-yield of stearaldehyde ($G \cong G_0$ 0.32) passes through a maximum (G_{max} 0.7) at about 12 Mrads; that of heptadecane shows complementary variation, suggesting possible common origin of the aldehyde and part of the hydrocarbon. α-Linked dehydrodimers (approximately equal amounts of the two possible diastereoisomers) are obtained in quantity (G 0.18) far less than stoichiometrically equivalent to heptadecane plus stearaldehyde, indicating extensive annihilation of α-radicals during irradiation, possibly via hydrogen atom or electron capture. Dehydrodimers linked elsewhere (than in the α position) are also present, but in still smaller quantity (G 0.025). (auth)

29107 MULTIPLE SCATTERING TREATMENT OF THE SOLVATED ELECTRON IN WATER. Moskowitz, J. M. (New York Univ., NY); Boring, M.; Wood, J. H. J. Chem. Phys.; 62: No. 6, 2254-2260(15 Mar 1975).

The multiple scattering method of molecular orbital computations was used to investigate the structure of an (excess) electron in water. The complex considered is a molecular ion consisting of four water molecules, situated on the vertices of a tetrahedron, plus the extra electron; the complex is placed in a dielectric cavity. The calculated excitation energy of 1.77 eV is in good agreement with the experimental value (1.72 eV). The computed equilibrium radius of the complex is in reasonable agreement with previous calculations. Determination of a second "2p" state (5e) lying near the b_2 state indicates another mechanism for the asymmetric line broadening of the absorption spectrum. Our computed self-consistent field potentials and charge densities are presented as they can be compared with previous model calculations. (auth)

29108 ACCELERATED RADIATION POLYMERIZATION OF VINYL-DIVINYL COMONOMER SYSTEMS. III. Activation and Secondary Reactions Between Tetraethylene Glycol Dimethacrylate and Chlorinated Monomers. Micko, M. M.; Paszner, L. (Univ. of British Columbia, Vancouver). J. Radiat. Curing; 2: No. 1, 19-24(Jan 1975).

Utilization of radiation polymerization derived exotherm heat of monomer/comonomer mixtures as energy (heat) source for complex chemical reactions was demonstrated with the multifunctional comonomer system of tetraethylene glycol dimethacrylate (TEGDMA)–chlorendic anhydride (CA)–hexachlorocyclopentadiene (HCCPD). In this system CA is used as activator and grafting agent for TEGDMA and wood, respectively, whereas the exotherm heat released during copolymerization was used to trigger condensation of the TEGDMA-CA copolymer with HCCPD in a Diels-Alder type reaction. This polymerization/condensation reaction allows incorporation of substantial amounts of chlorine in the three component polymer products. Generally, total radiation dose and maximum exotherm temperatures decreased with increasing molar ratios of TEGDMA and HCCPD, respectively. Comparatively favorable thermo-mechanical properties were obtained for the three component copolymers. (auth)

29109 EFFECT OF γ-IRRADIATION ON COAL. Lebedev, V. V.; Cheredkova, K. I.; Golovina, G. S.; Khrenkova, T. M.; Goroshko, V. D. Khim. Tverd. Topl.; No. 1, 165-166(1975). (In Russian).

Analytical data obtained from thermal destruction of irradiated and non-irradiated coal showed a decrease in hydrogen and carbon monoxide content, but increased levels of CH_4 and CO_2 with increasing dose of radiation. Thus, it has been shown that γ-irradiation has a profound effect on the structure of coal. (JPRS)

29110 ELECTRON TUNNELLING IN FROZEN MATRICES. Kroh, J.; Stradowski, C. (Politechnika Lodz, Poland). Int. J. Radiat. Phys. Chem.; 7: No. 1, 23-38(Feb 1975).

Experimental results are reported indicating that electrons can undergo scavenging after they are trapped in irradiated alkaline ice and other aqueous frozen solutions. Transfer of electrons to scavenger proceeds at 77°K in the course of irradiation and in the post-irradiation period. The influence of: (1) scavenger concentration, (2) the depth of electron trap, (3), time and (4) matrix composition on the rate of electron decay is consistent with a

model involving tunnelling of trapped electrons across a rectangular potential barrier. (auth)

29111 REACTIVITY OF COORDINATED NITROSYLS. V. Generation and Characterization of a Ruthenium (II) Alkylnitroso Complex. Armor, J. N.; Furman, R.; Hoffman, M. Z. (Boston Univ.). J. Amer. Chem. Soc.; 97: No. 7, 1737-1742(2 Apr 1975).

The radiolysis of $Ru(NH_3)_5NO^{3+}$ in aqueous tert-butyl alcohol solution generates the species $[Ru(NH_3)_5\{(NO)CH_2C(CH_3)_2OH\}]^{2+}$ which can be formally viewed as a Ru(II) alkylnitroso complex with a C–N bond. The complex has been isolated as the tetraphenylborate salt and has been characterized by elemental microanalysis, ion exchange chromatography, and uv-visible, ir, and nmr spectroscopy. The product can be envisioned as resulting from the attack of the carbon radical derived from the reaction of OH radicals with tert-butyl alcohol, $\cdot CH_2C(CH_3)_2OH$, with $Ru(NH_3)_5NO^{2+}$ generated by the reaction of H atoms and e^-_{aq} with the Ru(III) substrate. This stable, air-insensitive radical adduct can also be formulated as a Ru(III) nitroxide complex (valence tautomer). (auth)

29112 ELECTRON SPIN RESONANCE STUDIES OF FREE RADICALS IN SOLUTION III: pH DEPENDENCE OF THIYL FREE RADICAL OF CYSTEINE. Kertesz, J. C.; Wolf, M. B.; Wolf, W.; Chen, L. Y. A. (Univ. of California, Los Angeles). J. Pharm. Sci.; 63: No. 6, 880-883(Jun 1974).

An electron spin resonance flow technique was utilized to follow the concentration of thiyl free radicals (RS·) generated on the oxidation of cysteine with ceric ion over the 0.25 to 7.5 pH range. The thiyl free radical concentration decreased with increasing pH in a manner dependent on the extent of ionization of cysteine. The formation of thiyl free radicals was favored by the proportion of thiol present in the positively charged form. The diminution of RS· spin concentration at physiological pH was correlated with the increasing prevalence of singly and doubly negative thiolate ions. At acidic pH's below 1.5, thiyl free radical formation was depressed by solutions of high ionic strength. The utility of this technique in studying the potential role of thiyl free radicals in radioprotective processes is indicated. (auth)

29113 IRRADIATED INSOLUBLE AMYLOSE STARCH. Schirmer, H. G. (to W. R. Grace and Co.). US Patent 3,870,609. 11 Mar 1975. Filed date 25 Jan 1971. 6p.

This invention is directed to an irradiated starch with an increased insolubility and a high amylose content having at least about 20 percent insolubles in boiling water and 20 percent amylose and prepared by intimately contacting the starch with water to increase its moisture content and irradiating to a dosage of less than 10 megarads. (Official Gazette)

29114 LIQUID CHROMATOGRAPHIC DETECTION OF UNSTABLE PRODUCTS OF ORGANIC RADICAL REACTIONS. Radiolysis of Aqueous Solutions of Benzene and of α-Bromotetronic Acid. Bhatia, K. (Carnegie–Mellon Univ., Pittsburgh). J. Chromatogr. Sci.; 13: 84-85(Feb 1975).

As a result of the development of a liquid chromatograph (HPLC) with analytical reproducibility to within 1% and accuracy to ~2%, it was possible to rapidly detect unstable reaction products of radiolysis of benzene and of α-bromotetronic acid simply by a comparison of the chromatograms of the samples analyzed immediately upon the completion of the radiolysis and at known times thereafter. (auth)

29115 KINETIC STUDY BY PULSE RADIOLYSIS OF THE LACTATE DEHYDROGENASE-CATALYZED CHAIN OXIDATION OF NICOTINAMIDE ADENINE DINUCLEOTIDE BY HO_2 AND O_2^- RADICALS. Bielski, B. H. J.; Chan, P. C. (Brookhaven National Lab., Upton, NY). J. Biol. Chem.; 250: No. 1, 318-321 (1974).

The lactate dehydrogenase-catalyzed chain oxidation of NADH (LDH-NADH) by the superoxide radicals, HO_2 and O_2^-, was studied with pulse radiolysis in the pH range between 4.5 and 9.0. The rate constants for the oxidation of the LDH-NADH by HO_2 and O_2^- determined at 23° are 1.2×10^6 M^{-1} S^{-1} and 3.6×10^4 M^{-1} S^{-1}, respectively. The latter represents an activation of over 1000-fold by the enzyme. A chain reaction mechanism consistent with the results from these kinetic studies has been proposed. (auth)

29116 REACTION OF EXCESS ELECTRONS WITH ACCEPTOR MOLECULES IN LIQUID ISO-OCTANE. Boriev, I. A.; Yakovlev, B. S. (Chernovtsy Inst. of Chemical Physics, USSR). Int. J. Radiat. Phys. Chem.; 7: No. 1, 15-21(Feb 1975). (In Russian).

Rate constants of electron scavenging by pyrene and biphenyl were measured ($k = (2.0 \pm 0.3) \times 10^{-9}$ cm^3 s^{-1} at room temperature) as well as their temperature dependences within the range of 300 to 170°K. They were obtained from studies of the kinetics of radiation-pulse-induced conductivity solutions containing low concentrations of these scavengers (10^{13} to 10^{16} molecules cm^{-3}). The temperature dependence of the rate constants was found not to obey the Arrhenius expression. These results are compared with with the model comprising two (quasi-free and localized) electron states in iso-octane. It is concluded that the scavenging process involves mostly the localized electron. The analysis of the rate constants obtained, which were found not to be diffusion-controlled at least at room temperature, leads to the conclusion that scavenging of the localized electron by pyrene or biphenyl in iso-octane is an adiabatic process with an activation energy $E_0 \approx 0.01$ eV. The radius of electron scavenging was found to be $R \geq 1.1 \times 10^{-7}$ cm. (auth)

29117 ION-MOLECULE REACTIONS IN THE METHANE-ANILINE SYSTEM. Chojecki, M.; Luczynski, Z.; Wincel, H. (Inst. of Nuclear Research, Warsaw). Int. J. Radiat. Phys. Chem.; 7: No. 1, 7-14(Feb 1975).

The ion-molecule reactions in methane-aniline mixtures have been studied at pressures up to 2 torr (267 Nm^{-2}) over the temperature range 270 to 330°K in a high-pressure mass spectrometer. The main products observed are $(C_6H_5NH_2)_n^+$ and $C_6H_5NH_3^+(C_6H_5NH_2)_n$, where $n \leq 3$. The results are discussed in terms of the formation of the excited intermediates $(C_6H_5NH_2)_n^+$ from which solvated anilinum ions, $C_6H_5NH_3^+(C_6H_5NH_2)_{n-2}$, are produced. (auth)

29118 THERMOLUMINESCENCE (TL) OF POLYURETHANES (PU) AFTER X-RAY AND ULTRAVIOLET IRRADIATION. Korobeinikova, V. N.; Kazakov, V. P.; Aleev, R. S.; Chuvilin, Yu. N. (Inst. of Chemistry, Moscow). Vysokomol. Soedin., Ser. A; 16: No. 12, 2717-2724(Dec 1974). (In Russian).

Irradiation of PU with x ray and uv-radiation gives various TL curves. The difference in position of the maximum depends on the composition of PU and can attain 60°. It is proposed that uv-light ionizes the absorption centers, as a result of which the electron traps become populated; on the other hand it causes their "decolorization." These two processes lead to a redistribution of intensity in the TL maxima. It was found that cross-linking of the polymer by formation of triisocyanate bonds shifts the TL maximum to the side of higher temperatures. The position of the TL peak on the temperature scale correlates with known temperature changes of the spin-lattice relaxation times and the tangent of the mechanical losses which are connected with the thawing in mobility of CH_3 and CH_2 groups. Attention is called to the fact that the photoluminescence intensity begins to fall on increasing the temperature at the point where an increase in emission of the TL peak appears. Apparently the temperature quenching of PU photoluminescence is also caused by the increase in mobility of the CH_3 and CH_2 groups. Kinetic quenching curves in the TL peak were obtained after uv-irradiation at 77°K. In all cases the emission follows a hyperbolic law. The spectral region of the TL emission from polyurethanes (PU), which was determined by a set of light filters, coincides with the photoluminescence region. (SJR)

29119 EFFECT OF GAMMA IRRADIATION ON THE STRUCTURAL ORDERING OF POLYETHYLENE. Korodenko, G. D.; Karimov, S. N.; Sultanov, A. (Tadzhik State Univ., Stalinabad, USSR). Vysokomol. Soedin., Ser. A; 16: No. 12, 2651-2654(Dec 1974). (In Russian).

By infrared spectroscopy it is shown that during gamma irradiation of polyethylene in the presence of oxygen a non-equilibrium supermolecular structure is formed that becomes perfected and reconstructed during subsequent heatings. (SJR)

29120 FEATURES IN THE FORMATION AND STABILIZATION OF RADICALS IN POLYISOBUTYLENE ON IRRADIATION WITH VARIOUS TYPES OF IONIZING RADIATION. Pasal'skii, B. K.; Vonsyatskii, V. A.; Lavrentovich, Ya. I.; Kabakchi, A. M. (Inst. of Physical Chemistry, Moscow). Vysokomol. Soedin., Ser. A; 16: No. 12, 2762-2766(Dec 1974). (In Russian).

A study was made of the effect of ^{60}Co gamma radiation and of 22-MeV alpha particles on polyisobutylene (PIB) at liquid-nitrogen temperature. Equipment is described for irradiating polymers with heavy charged particles at 77°K. By an EPR method it is shown that in PIB radicals are stabilized of the type $-C(CH_3)_2-CH-C(CH_3)_2-$ whose concentration increases in proportion to absorbed dose. The radiation yield of radicals decreases with an increase in linear radiation energy transfer. Thus during gamma irradiation the radical yield is 2.1/100 eV and during alpha irradiation it is 0.451/100 eV. An analysis was carried out of the form of radical EPR spectral lines that showed that the width of the individual line increases in the dose interval above 5 Mrad during gamma irradiation, and with alpha irradiation it increases at doses above 150 Mrad. In these dose intervals the local radical concentration is close to average. It is shown that the destruction rate of radicals stabilized in PIB during alpha irradiation is higher than the destruction rate during gamma irradiation in the temperature interval from –70 to –50°. Radical destruction follows a second-order, kinetic equation. The effective activation

energy of the radical destruction process was found to be the same for both processes equal to 18 kcal/mol. However, the pre-exponential multiplier in the case of alpha-irradiated samples is about an order of magnitude higher than in the case of gamma-irradiated PIB. This behavior is explained by the different space distribution of the radicals. (SJR)

29121 RADIATION INDUCED PRECIPITATION POLYMERIZATION OF VINYL CHLORIDE IN A FLOW REACTOR. Dickey, L. C. Raleigh, NC; North Carolina State Univ. (1974). 134p. University Microfilms Order No. 75-5355.

Thesis (Ph. D.).

A bench scale pilot plant was constructed to investigate the feasibility of producing polyvinyl chloride of enhanced crystallinity by a heterogeneous γ-radiation initiated process. Objectives of the investigation were: (1) identify and characterize aspects of the polymerization and particle separation operations which would be crucial to further development of the process, and (2) determine the effects of medium agitation and composition on the polymer glass transition temperature and polymerization rate. Reactor clogging was found to be the pilot plant operating limitation of the most significance to further development. Low particle concentrations (up to 0.6% by weight) could not be separated from the circulating medium with either a miniature cyclone or a 40 liter settling tank. The particle settling rate was seen to be inversely related to the medium monomer concentration. The flow system, featuring fluid circulation through a 1.6 liter reactor at 4.5 liter/min., was modelled using results of a tracer study and a published model for jet-stirred vessels. Polymerization rates (.086 to .027 mole/hr.-mole), molecular weights (5500 to 8500 gram/mole), and glass transition temperatures (66 to 72°) were determined for monomer weight fractions from .1 to .15, polymerization temperatures from 16 to −6°, and a dose rate of .27 Mrad/hr. The molecular weights were comparable to those found for similar conditions in a preceding static polymerization study performed at this university. The polymerization rates were from .6 to .2 times those of the static study. The lower rates were in accord with findings reported for the precipitation polymerization of ethylene that fluid agitation decreases the rate of polymerization. The glass transition temperatures were at least 20° lower than the published values for polymer produced at equivalent temperatures. A modification of a model for vinyl chloride precipitation polymerization which was based on the static polymerization study is suggested. The modification restricts the propagation locus to the particle surfaces and assumes a steady number, at least as large as the number of particles in the polymerizing system, of surface phase elements, each containing at most one propagating radical. The modified model was used to explain the effect of agitation on the rate of polymerization. (Diss. Abstr. Int., B)

29122 MOLECULAR WEIGHT DISTRIBUTION OF POLYETHYLENE POLYMERIZED BY γ-RAY IRRADIATION UNDER VARIOUS POLYMERIZATION CONDITIONS. Hosoi, M. (Teijin Ltd., Sagamihara, Kanagawa (Japan). Plastic Research Inst.); Kuriyama, I.; Kawai, T. Sen'i Gakkaishi; 30: No. 4, 142-147 (Apr 1974). (In Japanese).

The molecular weight distributions of polyethylene polymerized by γ-irradiation in the gas phase under various conditions were investigated by GPC method. At the high polymerization temperature the distribution curve showed a single sharp peak, whereas at the low polymerization temperature it showed characteristic broad double peaks. The peak, corresponding to the high-molecular-weight species in the latter, becomes more intense with increasing polymerization pressure. The molecular weight distributions of the polymers obtained by a two-step polymerization also reveal double peaks characteristic of the low-temperature polymerization. In the second step polymerization, the rate of increase in the number of the polymer molecules is larger for the high-molecular-weight species. This tendency, which applies also to the usual one-step polymerization, suggests the existence of the long-lived radicals during the polymerization. The average molecular weight of the polyethylene sample obtained by shielding partly the irradiation with the lead block was always higher than that obtained without shielding, and the peak in the molecular weight distribution shifts towards the higher molecular weight region by shielding. All these results suggest that the addition of the monomer to the long-lived radicals trapped in the polymer precipitated would give rise to further growth of the chains and branching reaction (which leads to the formation of long-chain branches). (auth)

29123 PLYWOOD COMPRISING IONIZING RADIATION-CURED CROSS-LINKED DIALLYL PHTHALATE ACRYLONITRILE POLYMER AND METHOD OF MAKING. Gotoda, M.; Yokoyama, K.; Kono, Y.; Toyonishi, S.; Hiwano, K.; Shimoyama, T. (to Japan Atomic Energy Research Inst.). US Patent 3,869,341. 4 Mar 1975. Priority Date 9 May 1969, Japan, 14p.

A composition substantially comprising diallylphthalate prepolymer and acrylonitrile or a mixture of acrylonitrile and an alkylacrylate is cured by means of an electron beam as well as other ionizing radiations to form a cross-linked resin having excellent properties. A vinyl phosphate incorporated in the composition makes the cured coating anticorrosive and adhesive to metal surface. The composition is useful as a coating of adhesion agent, or for the manufacture of decorative plywood, colored coiled steel sheet, etc., and for preparing an anticorrosive paint. (Official Gazette)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

29124 THE NATURE OF THE CHEMICAL REACTIONS OF IODINE-128 FORMED IN THE NUCLEAR PROCESS $^{129}I(n,2n)^{128}I$ IN PRESENCE OF METHANE. Kuhry, J. G.; Heitz, C.; Paulus, J. M. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Chimie Nuclearie). Radiochim. Acta; 20: No. 1/2, 55-58(1973). (In French).

Iodine atoms activated by the $^{129}I(n,2n)^{128}I$ process reacting with methane led only to methyl iodide. The variations of the organic yields with the mole fraction of iodine and of rare gases (He, Ne, Ar, Kr, Xe) show that the involved mechanisms are mainly of thermal nature; hot yields are lower than 4%. The importance of the thermal processes is interpreted as resulting from the effects of the internal conversion of low lying levels in the deexcitation scheme of $^{128}I^*$, the lifetime of which exceeds the duration of the slowing down process of ^{128}I. (auth)

29125 A QUALITATIVE INVESTIGATION OF THE KINETIC SPECTRA OF RECOIL BROMINES FROM THE THREE NUCLEAR TRANSFORMATIONS: $^{79}Br(n,\gamma)^{80}Br$, $^{82m}Br(I.T.)^{82}Br$ and $^{80m}Br(I.T.)^{80}Br$. Saeki, M.; Tachikawa, E. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Div. of Chemistry). Radiochim. Acta; 20: No. 1/2, 27-32(1973).

The yields of products of the reactions with C_2H_6 of the recoil bromine from the $^{79}Br(n,\gamma)^{80}Br$ or the $^{82m}Br(I.T.)^{82}Br$ nuclear transformations were compared with those reported using the $^{80m}Br(I.T.)^{80}Br$ nuclear transformation. The product distribution characteristics of the nuclear transformation were determined both in the unmoderated and by extrapolation in the totally moderated system. On the basis of the fact that the product yield in the unmoderated system is primarily controlled by the kinetic spectrum of recoil bromines, it is concluded that roughly two thirds of the ^{82}Br atoms from the $^{82m}Br(I.T.)^{82}Br$ is available for the reactions with C_2H_6. In the $^{80m}Br(I.T.)^{80}Br$ process, a large fraction of the bromine is in or under the reaction energy range. Furthermore, a comparison of the yields of products in the totally moderated systems can provide an estimation of the probability of producing ionized bromine atoms in the $^{79}Br(n,\gamma)^{80}Br$ process. (auth)

29126 SEPARATION OF NUCLEAR REACTION PRODUCTS IN THE GAS PHASE. I. Separation of Tc in a Flow of Oxygen. Baechmann, K.; Matschoss, V. (Technische Univ., Darmstadt, Ger.). J. Inorg. Nucl. Chem.; 37: No. 1, 15-19(Jan 1975).

The separation of nuclear reaction products in the gas phase was investigated using a ^{252}Cf source. A detailed study of the behavior of Tc-nuclides which form a volatile oxide with oxygen has been carried out. The yields of technetium are given as a function of the oxygen concentration, the temperature of the cooling trap and the temperature of the transfer tube. The total yield of Tc is ≥ 50 ± 15 percent. (auth)

Properties of Radioactive Materials

Refer also to abstracts 28986, 28997, 28999, 29019, 29988, 30025, 30368, and 31567.

29127 (ANL-TRANS-976) ANODIC POLARIZATION OF UC IN A LiCl–KCl MELT. Knacke, O.; Krahe, J.; Muller, F. Translated from Z. Phys. Chem. (Leipzig); 50: 105-112(1966). 9p. Dep. NTIS $4.00.

The anodic polarization of a UC electrode was investigated by recording stationary potential-current curves according to the commutator method at 500°C. The cathode consisted of liquid tin or liquid lead, the electrolyte was a eutectic melt of LiCl–KCl with a uranium content of between 3 and 8 wt. % UCl_3 and Ag/AgCl was the reference electrode. Three characteristic potentials were found. According to thermodynamic calculations, these potentials are the result of saturation of the electrode/electrolyte phase boundary with UCl_3, UCl_4 and the evolution of gaseous chlorine. In the UCl_4 saturation range, a limiting current of about 2.5 amp/

cm^2 is observed. In the cathode, the USn_3 or UPb_4 phase is separated even after a short electrolysis period. Polarization of the two-phase cathode Sn–USn_3 was insignificant up to current densities of –50 m amp/cm^2. (auth)

29128 (LA-5876-MS) COPRECIPITATION OF URANIUM AND PLUTONIUM OXALATES USING SODIUM FORMALDEHYDE SULFOXYLATE REDUCTION AND DIETHYL OXALATE HYDROLYSIS PRECIPITATION. Marsh, S. F.; Ortiz, M. R.; Rein, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-ENG-36. 2p. Dep. NTIS $4.00.

A procedure was developed for preparing a crystalline coprecipitate of uranium and plutonium. From nitric acid media, uranium and plutonium are reduced to U^{4+} and Pu^{3+} then coprecipitated as oxalates by hydrolysis of diethyl oxalate. (auth)

29129 (ORO-4447-016) SYNTHESIS AND PROPERTIES OF BERKELIUM METAL AND COMPOUNDS. Peterson, J. R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Oak Ridge National Lab., Tenn. (USA)). [nd]. 26p. (CONF-750112-1). Dep. NTIS $4.00.

From symposium commemorating the 25th anniversary of the discovery of elements 97 and 98; Berkeley, USA (20 Jan 1975).

Preparation of Bk metal, BkO_2, BkF_3, Bk_2O_3, $BkCl_3$, and BkOCl is discussed. Heat of solution data for Bk metal are given. (LK)

29130 SYNTHESIS OF RADIO-ISOTOPICALLY LABELLED PHOSPHATIDYLETHANOLAMINES. Billimoria, J. D.; Owen, J. S.; Scott, G. H. (Westminster Medical School, London). Chem. Phys. Lipids; 12: No. 4, 327-343(Jul 1974).

The total chemical synthesis of di and tri-radioisotopically labelled 1-2 dipalmitoyl-sn-glycero-3-phosphorylethanolamine (PE) labelled with ^{14}C-(diacyl) and ^{32}P and ^{14}C-(diacyl), ^{32}P and ^{3}H(ethanolamine) are described. Due to the short half-life of the ^{32}P isotope in the time-consuming synthesis of the intramolecularly tri-labelled compound, ^{32}P activity would be considerably low in relation to ^{14}C and ^{3}H at the end of such a synthesis. It was therefore decided to separately build three identical molecular species, individually labelled with ^{32}P, ^{14}C, and ^{3}H and mix these in appropriate quantities to obtain a tri-intermolecularly labelled mixture which would be chemically and biologically indistinguishable from the tri-intramolecularly labelled PE. Synthesis of a dilinoleoyl, a mixed acid phosphatidyl ethanolamine and a ^{14}C, ^{32}P lecithin are also described. (NL)

29131 STUDIES ON THORIUM PHOSPHATE ION EXCHANGER. II. Distribution Coefficient Measurements and Selective Ion-Exchange Separations of Some Metal Ions. De, A. K.; Chowdhury, K. (Visvabharati Univ., Santiniketan, India). J. Chromatogr.; 101: No. 1, 73-78(Dec 1974).

Distribution coefficients of metal ions on thorium phosphate exchanger were determined at pH 2 to 3 and at pH 5.5 to 6.5. The distribution coefficients were higher for lead, bismuth, and iron(III) than for other metals. On the basis of the distribution coefficients, separations of Pb^{2+} from Cu^{2+}, Cd^{2+}, Zn^{2+}, Ca^{2+}, Mg^{2+}, Co^{2+}, Mn^{2+} and Hg^{2+}, and of Bi^{3+} from Zn^{2+}, Cu^{2+}, Co^{2+}, Cd^{2+}, Ni^{2+} and Hg^{2+}, were achieved with thorium phosphate. (NL)

29132 THERMAL DECOMPOSITION OF METAL COMPLEXES. III. Uranyl Nitrate Adducts with N-Donor Ligands. Gurrieri, S.; Maggiore, R.; Musumeci, S.; Siracusa, G. (Univ., Catania, Italy). Thermochim. Acta; 11: No. 1, 73-77(1975).

The thermal decomposition of some uranyl nitrate adducts with neutral N-donor ligands was investigated in order to correlate the "activation energy", E_a, of the first step, whose shape depends on the kind of the neutral ligand, with the antisymmetric stretching vibration ν_3 of the O–U–O group. The linear relationship $\bar{\nu}_3 = 883 + 0.596E_a$ was found. Some considerations about the identification of the symmetric stretching band ν_1 have been drawn. (NL)

29133 STUDIES ON THORIUM PHOSPHATE ION EXCHANGER. I. Synthesis, Properties, and Ion-Exchange Behaviour of Thorium Phosphate. De, A. K.; Chowdhury, K. (Visvabharati Univ., Santiniketan, India). J. Chromatogr.; 101: No. 1, 63-72(Dec 1974).

Thorium phosphate was prepared by mixing solutions of 0.1 M $Th(NO_3)_4 \cdot 4H_2O$ in nitric acid and phosphoric acid. Four different thorium phosphate materials were obtained under various conditions with PO_4:Th ratios of 1.9, 2.1, 1.69, and 1.9. Preparative procedures, chemical stability, derivative thermogravimetric analysis results and infrared spectra of these materials are reported and discussed. (NL)

29134 LABELLING ANTIBODIES WITH ^{131}I BY THE CHLORAMINE-T METHOD. Model Tests with Rabbit Gamma-Globulin and Horse Albumin Antibodies. Schmidt, H. E. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig); Teichmann, B.; Vogt, R.; Herzmann, H. Isotopenpraxis; 10: No. 11-12, 401-407(1974). (In German).

Model tests are described which imply labelling of rabbit gamma-globulin and horse albumin antibodies with regard to labelling anti-tumor antibodies with ^{131}I at the same time preserving as much as possible their immunological activity (precipitation capability in vitro). With substitution level ranging up to 1.2 iodine atoms per antibody molecule, a decrease of precipitation capability is to be realized which apparently is due to the effect of sodium disulfite used in excess (oxidation stop reagent for chloramine-T action). (auth)

29135 LABELLING, FRACTIONATION AND TOXICITY OF HONEY BEE (APIS MELLIFERA) VENOM USING ^{125}I AND GEL-FILTRATION TECHNIQUE. Abdel-Wahab, M. F.; Abdo, M. S.; Megahed, Y. M.; Farahat, A. A.; Hassan, K. A. (Atomic Energy Establishment, Cairo). Isotopenpraxis; 10: No. 11-12, 413-415 (1974).

^{125}I was used for labelling honey bee venom before fractionation on Sephadex G-25 and Sephadex G-100. Both radioactivity and extinction curves denoted the presence of four well-defined peaks. The toxicity of the first peak was found to be the lethal one for mice. While the other successive three peaks proved to be nontoxic to both mice and rats, up to a dose of 197.76 mg/kg body weight, and 241.11 mg/kg body weight respectively. (auth)

29136 HOT SYNTHESES IN THE SYSTEM CHLOROALANINE-HCl. Wagner, G.; Muenze, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 11: No. 2, 58-63 (Feb 1975). (In German).

During reactor irradiation of chloroalanine in hydrochloric solution (n_{th}: $5 \cdot 10^9$ n cm^{-2} s, n_f: $5 \cdot 10^8$ n cm^{-2} s, D: $5 \cdot 10^4$ rd/h) ^{35}S labelled sulphate, alkylsulfonic acids, cysteic acid and other sulfur containing amino acids have been generated in carrier-free form. The fraction of cysteic acid grows with increasing HCl-concentration (1.4–4.38 m/l) after 345 h irradiation from 1.4 up to 21.8% (concentration of chloralanine 1.6 m/l). Under the same conditions the SO_4^{2-}-alkyl sulfonic acid fraction decreases from 77.1 to 10.1%. The yield of neutral labelled amino acids diminishes from 18.5% to 8.5%. Firmation possibilities of these products have been studied and discussed. (auth)

29137 PREPARATION OF AN ANION-DEFICIENT ACTINIDE NITRATE SOLUTION. (to Stichting Reactor Centrum Nederland). Netherlands Patent 7,207,572. 5 Jun 1972. 7p. (In Dutch).

A method is provided for the preparation of an anion-deficient actinide nitrate solution. A hydrated actinide nitrate is used instead of an aqueous actinide salt solution. (NL)

29138 OBSERVATION AND ANALYSIS OF THE OPTICAL ABSORPTION AND FLUORESCENCE SPECTRA OF GREEN-COLORED Np:CaF_2. Natarajan, A.; Wang, S.D.; Artman, J.O. (Departments of Physics and Electrical Engineering and Mellon Institute, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 62: No. 7, 2707-2719 (1 Apr 1975).

The optical absorption spectra seen at room and cryogenic temperatures in green-colored Np:CaF_2 crystals have been attributed to Np^{3+} substitution at Ca^{2+} [000] sites with three distinct modes of charge compensation and correspondingly lowered local symmetries. These are: *A*, C_{1v} symmetry associated with the presence of an F^- compensator at empty [(1/2)(1/2)(1/2)]-type sites; *B*, C_{1v} symmetry related to the replacement of a *nn* F^- at a [(1/4)(1/4)(1/4)]-type position by O^{2-}; *C*, C_{4v} symmetry attributed to the presence of an F^- compensator at empty [00(1/2)]-type sites. A two-parameter fit to the five lowest excited multiplet centers yielded the following F_2 and ζ values (in cm^{-1}): *A*, 214.5 and 2032; *B*, 212.7 and 2001; *C*, 219.1 and 2083. The multiplet splittings of each of these three spectra have been fit with crystal potential ("crystal-field") parameters. Fluorescence, consisting of several broad bands near 1.4 μm and four lines near 2.5 μm, was associated with the Np^{3+} type-C sites. At liquid He temperature, the 2.5 μm spectrum consisted of just one sharp line at 3929 cm^{-1}. Vibrational effects were largely absent, both in absorption and fluorescence. (auth)

29139 MODEL CALCULATION OF VIBRONIC SIDEBANDS IN Cs_2UBr_6. Chodos, S.L.; Satten, R.A. (Department of Physics, University of California, Los Angeles, California 90024). J. Chem. Phys. 62: No. 6, 2411-2417 (15 Mar 1975).

A simple seven parameter lattice dynamics model for Cs_2UBr_6, employing a Urey–Bradley valence force field for the short range interactions and standard long range Coulomb terms, was used to calculate the shape of vibronic side bands accompanying a $\Gamma_{1g} \rightarrow \Gamma_{1g}$ and a $\Gamma_{1g} \rightarrow \Gamma_{2g}$ electronic transition. Simplifying assumptions concerning the vibronic interaction were made. The results were fairly good and instructive for the sideband accompanying the Γ_{2g} electronic transition partly because the vibronic effective Hamiltonian was more realistic in that case. (auth)

29140 THE VAPOR PRESSURE OF HIGH–PURITY SOLID AND LIQUID CURIUM. Ward, J.W.; Ohse, R.W.; Reul, R. (Europäisches Institut für Transurane, EURATOM, P.O. Box 2266, 75 Karlsruhe, Federal Republic of Germany). J. Chem. Phys. 62: No. 6, 2366-2372 (15 Mar 1975).

The vapor pressure of triply–distilled curium–244 metal has been measured in the temperature range 1300–2000 K, using Knudsen effusion target–collection techniques. Precise geometrical conditions were chosen to insure that the intercepted molecular beam came entirely from the curium sample surface within the cell. Second–law equations are $\log_{10}P$ (atm) = (6.082±0.129) – (19618±193)/T (K) (solid, 1327–1639 (K), $\log_{10}P$ (atm) = (5.586±0.157) – (18894±275)/T (K) (liquid, 1640–1972 (K). From these data, the heat and entropy of fusion/transition are calculated to be 3.31 kcal and 2.19 cal/deg, respectively. The average second–law entropy is 25.56±0.72 cal/deg. Similarities noted in other work between the chemical and physical properties of curium and gadolinium were clearly evident. Free–energy functions for gadolinium were used directly to give ΔH_{298K} (3rd–law) = 92128±76 cal for the heat of sublimation from the solid phase, and 92482±112 cal for the liquid. Difficulties encountered in high–temperature effusion studies with reactive materials are discussed in the light of these and earlier results. (auth)

29141 INFRARED AND RAMAN SPECTRA OF THE URANYL ION. Bagnall, K. W.; Wakerley, M. W. (Univ. of Manchester, Eng.). J. Inorg. Nucl. Chem.; 37: No. 1, 329-330(Jan 1975).

Several attempts have been made to correlate the frequencies of the symmetric (ν_1) and asymmetric (ν_3) O–U–O stretching modes in complexes of the types $K_xUO_2L_y(NO_3)_2$, $UO_2(NO_3)_2L_2$ and $UO_2Cl_2L_2$ with the position of the ligand L in the spectrochemical series. A report is presented on the IR and Raman spectra of some recently prepared phosphine oxide complexes of uranyl perchlorate and nitrate and of some uranyl alkyl phosphate and phosphinate compounds. The results are discussed. (auth)

29142 MOESSBAUER SPECTRA OF ^{237}Np IN ION EXCHANGE RESINS AND IN A SOLVENT EXTRACTANT. Claussen, C. A.; Stone, J. A. (Du Pont de Nemours (E. I.) and Co., Aiken, SC). J. Inorg. Nucl. Chem.; 37: No. 1, 261-264(Jan 1975).

A Mössbauer effect has been observed for Np(IV) ions sorbed on a cation exchange resin from HNO_3 and HCl solutions and for $[NpCl_6]^{-2}$ and $[Np(NO_3)_6]^{-2}$ complexes sorbed on an anion exchange resin. Mössbauer spectra have also been recorded for $[NpCl_6]^{-2}$ and $[Np(NO_3)_6]^{-2}$ complexes extracted into a tri-n-octylamine–benzene solution. The isomer shifts and quadrupole splittings for the sorbed and extracted species have been found to agree, but the quadrupole splittings were found to differ from those observed for the parent compound in the crystalline state. The Mössbauer spectra for all noncrystalline systems at 4.2°K were found to be dominated by magnetic hyperfine splitting. (auth)

29143 SYSTEM URANYL CHLORIDE-WATER. Phase Relationships in the System UO_3–HCl–H_2O. Prins, G.; Cordfunke, E. H. P. (Stichting Reactor Centrum Nederland, Petten). J. Inorg. Nucl. Chem.; 37: No. 1, 119-121(Jan 1975).

The phase diagram of the system UO_3–HCl–H2O has been determined. Five solid phases have been found: $UO_2Cl_2 \cdot 3H_2O$, $UO_3 \cdot 2H_2O$, the basic salt $UO_2(OH)Cl \cdot 2H_2O$ or $[(UO_2)_2(OH)_2Cl_2(H_2O)_4]$, the basic salt $2UO_3 \cdot HCl \cdot 4H_2O$ or $[(UO_2)_4O_2(OH)_2Cl_2(H_2O)_6] \cdot 2H_2O$, and the metastable basic salt $4UO_3 \cdot HCl \cdot 8H_2O$. (auth)

29144 INCORPORATION OF [α-^{2}H]- AND [α-^{3}H]-L-CYSTINE INTO PENICILLIN G AND THE LOCATION OF THE LABEL USING ISOTOPE EXCHANGE AND ^{2}H NUCLEAR MAGNETIC RESONANCE. Bycroft, B. W.; Wels, C. M.; Corbett, K.; Lowe, D. A. (Univ. of Nottingham, Eng.). J. Chem. Soc., Chem. Commun.; No. 4, 123(19 Feb 1975).

The feeding of L-[α-^{2}H]- and L-[α-^{3}H] cystine to Penicillium chrysogenum affords [6-^{2}H]- and [6-^{3}H]-penicillin G, thus confirming that an $\alpha\beta$-dehydrocysteine residue is not involved in the biosynthetic pathway. (auth)

29145 ROOT-MEAN-SQUARE AMPLITUDES IN SOME HEXAFLUORIDES OF OCTAHEDRAL SYMMETRY. Nagarajan, G.; Adams, T. S. (Valdosta State Coll., GA). Z. Phys. Chem. (Leipzig); 255: No. 5, 869-888(1974).

A brief survey of the vibrational and structural analysis for the hexafluorides of sulfur, selenium, tellurium, molybdenum, technetium, ruthenium, rhodium, tungsten, rhenium, osmium, iridium, platinum, uranium, neptunium, and plutonium possessing an octahedral symmetry has been made. On the basis of group theoretical considerations, the potential energy constants have been evaluated by employing a most general harmonic force field. The L matrix elements connecting the internal coordinates and normal coordinates have been derived from the known symmetrized force constants, G matrix elements, and vibrational frequencies. The mean-square amplitudes, and root-mean-square amplitudes for both bonded and nonbonded atom pairs have been computed at the temperatures 298°K and 500°K. The results have been discussed in relation to the nature of the characteristic bonds in these fifteen hexafluorides. (auth)

29146 REDUCTION OF Tc(IV) COMPOUNDS AT NOBLE METAL ELECTRODES. Muenze, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 11: No. 1, 29-30 (Jan 1975). (In German).

The processes occurring at Hg and Au electrodes were studied for $TcCl_6^{2-}$ and $TcBr_6^{2-}$. A typical current-voltage diagram is shown for $TcCl_6^{2-}$ reduction in HCl. The dependence of the half-stage potential on the Cl^- concentration was established. The $TcBr_6^{2-}$ current-voltage curve has a similar pattern. As in HCl solutions reversible single electron stages were observed whose half-stage potential depends on the HBr activity. No current-voltage curves could be obtained for TcI_6^{2-}. (JSR)

29147 DETERMINATION OF RADIOCHEMICAL PURITY AND RADIOPROTEIN CONTENT. Berkes, I. (Institut fuer Biochemie, Belgrad); Jovanovic, V.; Bzenic, J. Isotopenpraxis; 11: No. 1, 18-20(Jan 1975). (In German).

The chromatographic and electrophoretic method of determination of the radiochemical purity of radioprotein is described. The spectrophotometric method has been applied for the quantitative determination of radioprotein, using Folin's reagent. The addition of 0.9% of benzyl alcohol as a preserving agent to the radioprotein reduced content values compared with samples free from benzyl alcohol. (auth)

29148 X-RAY DIFFRACTION STUDIES OF DIELECTRIC EVAPORATED FILMS. Ahrens, H. (Technische Univ. Hannover (F.R. Germany). Inst. fuer Angewandte Physik); Salje, E. (Technische Univ. Hannover (F.R. Germany). Mineralogisches Inst.). Z. Kristallogr.; 140: No. 1/2, 137-144(Oct 1974). (In German).

Thin films of ZnS, ZnSe and ThF_4 were prepared by evaporation and studied by means of x-ray diffraction. It was found that all films possessed a specific crystal orientation varying with evaporation parameters. (auth)

29149 CONTRIBUTION TO THE ELECTROCHEMICAL STUDY OF PLUTONYL IONS. Musante, Y.; Ganivet, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Service de Fabrication et d'Examens Radiometallurgiques). Bull. Soc. Chim. Fr.; No. 9, 1859-1865(Sep 1974). (In French).

Plutonyl perchlorate solutions were prepared at various pH. The existence ranges of various hydroxylated and condensed forms were delimited by electrochemical studies and acidimetric titrations. Results were compared to recent works on this subject. A new ionic form $(PuO_2)_2(OH)^{3+}$, investigated by the so-called potentiometric surface method was observed in low pH systems. (FR)

29150 DOUBLE Th AND Np(IV) ORTHOVANADATES AND ARSENATES WITH ALKALI METALS; V–As SUBSTITUTION ON TETRAHEDRAL SITES. Freundlich, W.; Erb, A. (Paris-6 Univ., 75 (France)); Pages, M. (Institut du Radium, 75 - Paris (France). Lab. Curie). Rev. Chim. Miner.; 11: No. 5, 598-606 (1974). (In French).

Two series of compounds, $M_2A(XO_4)_2$ and $MA_2(XO_4)_3$ were prepared, where M = Li, Na; A = Th, Np; X = As, V. In the first series, only $Na_2A(AsO_4)_2$ and $Li_2Th(AsO_4)_2$ were obtained. The orthovanadates, $MNp_2(VO_4)_3$, have the zircon structure, like the analogous thorium compounds. The orthoarsenates, $MA_2(AsO_4)_3$ are superstructured in the case of neptunium and monoclinic in the case of thorium. The progressive replacement of vanadium by arsenic in the $MA_2(VO_4)_3$ phases gives rise to a continuous disorder order transition. (FR)

29151 THE CHEMICAL BEHAVIOR OF ^{125}I PRODUCED BY ELECTRON CAPTURE OF ^{125}Xe IN THE GASEOUS PHASE. P, 3. Cyclopropane. Certout, G.; Schleiffer, J. J. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Chimie Nucleaire). Radiochim. Acta; 20: No. 1/2, 69-72 (1973). (In French).

The formation of organic iodides, resulting from electron capture decay of ^{125}Xe, has been studied in the presence of cyclopropane. The organic yield is insignificant in the gaseous mixtures of ^{125}Xe-c-C_3H_6; this behavior is attributed to the decomposition of the organic iodides by free electrons and by the radicals resulting from the Auger effect. In the presence of an electron scavenger, the formation of iodides results from reactions of $^{125}I^+$ ions in the ^3P state, or from reactions of ^{125}I with radiolytic products of the substrate. When the additive is also a radical scavenger the main product is n-propyliodide which is formed by direct reactions of $^{125}I^+$ on c-C_3H_6 or by intermediate compounds such as $^{125}IO_2$. (auth)

29152 CHEMICAL BEHAVIOR OF ^{125}I FORMED BY ELECTRON CAPTURE OF ^{125}Xe IN THE GASEOUS PHASE. P. 1. Methane. Schleiffer, J. J.; Certout, G. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Chimie Nucleaire). Radiochim. Acta; 20: No. 1/2, 59-65(1973). (In French).

The chemical forms of ^{125}I produced in the electron capture decay of ^{125}Xe in the presence of gaseous methane were investigated. The organic yield is low (0.6-0.3%) in a xenon-methane mixture, but increases markedly in the presence of various additives acting as electron or radical scavengers, or participating in charge transfer processes. The results point out the role of the electrons and radicals resulting from the Auger effect and the necessity of the neutralization of intermediate RI^+ species in order to stabilize organic ^{125}I-iodides. (auth)

29153 CHEMICAL BEHAVIOR OF ^{125}I FORMED BY ELECTRON CAPTURE OF ^{125}Xe IN THE GASEOUS PHASE. P. 2. Ethane, Propane, Butane. Schleiffer, J. J.; Certout, G. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Chimie Nucleaire). Radiochim. Acta; 20: No. 1/2, 66-68 (1973). (In French).

The chemical forms of ^{125}I formed in the electron capture decay of ^{125}Xe in the presence of gaseous ethane, propane, and butane were determined. The organic yields are higher in these systems compared to methane–xenon mixtures. For the interpretation of this fact, a reaction mechanism is proposed. The influence of the mole fraction of xenon in the gas mixture as well as the influence of iodine additions are studied. (auth)

29154 OXYFLUORIDES OF THE PEROVSKITE TYPE CONTAINING HEXAVALENT URANIUM. Charvillat, J. P.; Sabatier, R.; Baud, Gilbert (Clermont-Ferrand Univ., 63 - Aubiere (France)). Bull. Soc. Chim. Fr.; No. 11, 2373-2378(Nov 1974). (In French).

New oxyfluorinated perovskytes of the types $A_2(I)B(I)U(VI)O_3F_3$ (for A = Cs, B = Cs, Rb, K; for A = Rb, B = Rb, K) and $A_2(II)B(I)U(VI)O_3F$ (A = Ba; B = Na, Li) containing hexavalent uranium were prepared by reaction in the solid state. Except $Cs_2UO_3F_3$, which shows a quadratic deformation, all these compounds are cubic; their crystallographic characters are described (space group, distribution of cations in the octahedral sites), and their conditions of existence are discussed. For the oxyfluorides $A_2BUO_3F_3$, the various substitution possibilities in both the types of cationic site are reviewed. The existence of vacancy perovskites $A_2(II)B(I)U(VI)O_{5.5}$ (A = Ba; B = Na, Li) with an orthorhombic symmetry is also demonstrated. (FR)

29155 THE CONTAINMENT OF ^{233}U IN THE PROCESSING FACILITIES OF THE ORNL PILOT PLANT. Brooksbank, R. E.; Parrott, J. R.; Youngblood, E. L.; McDuffee, W. T. (Oak Ridge National Lab., Tenn. (USA)). pp 229-247 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.); Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The ORNL Pilot Plant has been engaged in the handling and processing of ^{233}U for 15 years. The various operations utilized for storage, purification, and conversion to oxide are outlined. Methods of containment used with vessels, remote processing cells, glove-box fabrication systems, and plant effluent systems are emphasized. The surveillance experience gained during the operational period is summarized. (FR)

29156 PRODUCTION AND LABELLING OF MONODISPERSE POLYSTYRENE AND POLYSTYRENE-VINYLTOLUENE COPOLYMER LATEXES. Szende G.; Udvarhelyi, K. (Kozponti Fizikai Kutato Intezet, Budapest). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 53-56(Feb 1975).

The silicosis research in the authors' laboratory requires as test material a monodisperse aqueous suspension or aerosol, of colloidal particle size, radiolabelled with a γ emitter, which does not cause any damage in the living organism into which it is introduced. A method of production of the appropriate polystryene and polystyrene-vinyltoluene copolymer latexes was developed. The particle size of the monodisperse latexes produced reproducibly by emulsion-polymerization is of the order of 0.1 to 1.5 μm. The PS latexes were labelled with ^{51}Cr, incorporated into the particles in the form of ^{51}Cr-acetylacetonate in the course of polymerization. The monodisperity of the products was established from electron microscopic pictures and particle size analyzer data. The ratio of the ^{51}Cr activity was determined in the solid polystyrene particles and the aqueous media as well as the stability of this ratio was measured both in vitro and in vivo. (auth)

29157 HEAT TRANSFER COEFFICIENTS FOR CONCENTRATED URANYL NITRATE SOLUTIONS IN A THERMOSIPHON EVAPORATOR. Levins, D. M.; Alfredson, P. G. (Australian Atomic Energy Establishment, Lucas Heights). Mech. Chem. Eng. Trans.; 10: No. 2, 39-43(1974).

A method for estimating heat transfer coefficients for the evaporation of concentrated uranyl nitrate solutions is described, based on data obtained in a thermosiphon evaporator at uranium concentrations up to 1000 g/liter. The method is also applicable to other systems when an evaporator must be designed in the absence of adequate physical data. Results are correlated using an empirical factor which accounts for the change in physical properties of the boiling solution with concentration and enables heat transfer coefficients to be predicted from conventional heat transfer correlations using physical property data for water. The performance of the thermosiphon evaporator, with a heat transfer area of 0.74 m^2, is reported in terms of the effects of steam pressure, uranium concentration and liquid submergence on the overall heat transfer coefficients which varied in the range 1.4–2.5 kW m^{-2} K^{-1}. (auth)

29158 TECHNETIUM–PHOSPHINE COMPLEXES. Diethylphenylphosphonite Complexes of Technetium(III) and Mixed Ligand Complexes of Technetium(I) with Carbonyls and Diethylphenylphosphonite, and Crystal and Molecular Structure of cis-dicarbonyltetrakis(diethylphenylphosphonite)technetium(I)perchlorate. Cingi, M. B. (Univ., Parma, Italy); Clemente, D. A.; Magon, L.; Mazzi, U. Inorg. Chim. Acta; 13: No. 1, 47-59(Apr 1975).

By reaction of trans-$[TcX_2(P(OEt)_2Ph)_4]ClO_4$ (X = Cl, Br, I) with carbon monoxide at room pressure, the cis- and trans-$[Tc(CO)_2(P(OEt)_2Ph)_4]ClO_4$ isomers were obtained. To this purpose the complexes trans-$[TcX_2(P(OEt)_2Ph)_4]Y$ (X = Br, I and Y = ClO_4^-, I^-) were therefore synthesized. The formulation of all complexes is substantiated by elemental analysis, magnetic and conductivity measurements, IR and ^1H NMR spectra and for the cis-isomer also by x-ray analysis. In the latter complex the technetium atom presents an octahedral coordination with some degree of distortion. The four Tc–P distances are 2.38(1), 2.41(1), 2.44(1), 2.44(1) Å, and the two Tc–CO distances are both 1.90(2) Å. (auth)

29159 CHRONOPOTENTIOMETRIC AND CHRONOAMPEROMETRIC INVESTIGATIONS OF URANIUM(VI) IN MOLTEN CONDENSED PHOSPHATES. Miglio, J. J. Albuquerque, NM; Univ. of New Mexico (1974). 160p. University Microfilms Order No. 75-5903.

Thesis (Ph. D.).

The diffusion coefficient, D, of U(VI) in molten sodium metaphosphate at 694°C was determined by two independent methods. D was also determined at R values of 1.0, 1.1, 1.2, 1.3, 1.4, and 1.5, where R is the molar M_2O to P_2O_5 ratio and M is univalent. The relative amounts of various phosphate species present in the molten state were determined by thin layer chromatography after rapidly cooling the melt and dissolving the resultant glass in water. With the above information it was hoped to determine if D is independent of the experimental method of determination and then to relate the variation of D with R. A three electrode system was employed for chronopotentiometry, a 1 cm^2 platinum flag working electrode, a platinum flag counter electrode (>10 cm^2), and a silver-silver metaphosphate reference electrode. Fused silica crucibles were used to contain the melts. The melts were allowed to equilibrate at 694°C for at least one hour prior to the taking of measurements. There appeared to be no regular variation in D with increasing R. For R equals 1.0, 1.1, 1.2, 1.3, 1.4, and 1.5, the diffusion coefficients were 1.30×10^{-7} cm^2/sec, 6.29×10^{-8} cm^2/sec, 1.67×10^{-7} cm^2/sec, 2.24×10^{-7} cm^2/sec, 1.48×10^{-7} cm^2/sec, and 2.12×10^{-7} cm^2/sec respectively. The diffusion coefficients were obtained from the slopes of $i_0 \tau^{1/2}$ vs. C plots. For chronoamperometry a two electrode system was employed. A potential of 0.85 volts was selected after studying current-voltage curves for the melts. Unlike chronopotentiometry, D values determined by chronoamperometry increased fairly regularly with R. For R values of 1.0, 1.1, 1.2, 1.3, 1.4, and 1.5 the corresponding D values were 1.16×10^{-7} cm^2/sec, 1.47×10^{-7} cm^2/sec, 1.62×10^{-7} cm^2/sec, 1.96×10^{-7} cm^2/sec, 2.12×10^{-7} cm^2/sec, and 2.45×10^{-7} cm^2/sec. The thin layer chromatography consisted of dissolving the glass in water and spotting the solution on to an Eastman cellulose chromatographic sheet. The solvent was a mixture of trichloroacetic acid, water, ammonia, and acetone. The spots were developed by an acid molybdate spray followed by exposure to ultraviolet light. The spots were then eluted off the sheet and the percent phosphorus determined colorimetrically. The results show that the uranium does change the amount of the various phosphate species present. The application of the Stokes-Einstein equation indicates that the radius of the diffusing species, for an R = 1.0 melt, is the bare U(VI) ion. In light of the known chemistry of uranium, the existence of a bare U(VI) ion seems very improbable. (Diss. Abstr. Int., B)

29160 REDUCTION OF THE CHROMIUM(III)–NEPTUNIUM(V) COMPLEX BY NEPTUNIUM(III). Hinderberger, E. J. Jr. (Univ. of Missouri, Columbia); Thompson, R. C. Inorg. Chem.; 14: No. 4, 784-786(Apr 1975).

The empirical rate law for the reaction $Np^{III} + Cr^{III}{\cdot}Np^{V} = 2Np^{IV} + Cr^{III}$ in acid perchlorate solution is $-d[Np^{III}]/dt = k[Cr^{III}{\cdot}Np^{V}][Np^{III}][H^{+}]^{0}$. Values of $k = (1.6 \pm 0.1) \times 10^{3}$ M^{-1} sec^{-1}, $\Delta H^{*} = 2.6 \pm 0.1$ kcal/mol, and $\Delta S^{*} = -35._{3} \pm 0._{4}$ cal mol^{-1} deg^{-1} were determined at 25°, I = 0.50 M ($LiClO_4$). A comparison with the $Np^{III}-Np^{V}$ reaction suggests that the coordinated Cr^{III} is much more effective than H^{+} at promoting reduction of Np^{V}. The rate law implies an activated complex with a formal charge of 7+, a rarity in ionic reactions. The $S^{*}(CrONpONp^{7+})$ is estimated to be –144 cal mol^{-1} deg^{-1}, a value in harmony with an extension of the previously noted approximate correlation between the formal charge and entropy of activated complexes. (auth)

29161 RADIOISOTOPES DEVELOPMENT IN GREECE. Constantinides, M. G. (Greek Atomic Energy Commission, Athens). pp 49-56 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Production of the following radiopharmaceuticals is discussed: ^{99m}Tc-sulfur colloid; ^{99m}Tc-human serum albumin; ^{99m}Tc-1-hydroxy-ethylidene-1,1-disodium phosphate; and ^{131}I-sodium o-iodohippurate. (LK)

29162 PRODUCTION OF RADIOISOTOPES IN POLAND. Deptula, C. (Inst. of Nuclear Research, Swierk, Poland). pp 59-71 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

The following kits used for medical in-vivo diagnostics are described: colloids labeled with ^{99m}Tc or ^{113m}In for liver and spleen scintigraphy; macroaggregates labeled with ^{99m}Tc or ^{113m}In for lung scintigraphy; complexes ^{99m}Tc and ^{113m}In with DTPA for kidney scintigraphy, brain tumor localization, and for examination of glomerular filtration; human transferrin labeled with ^{113m}In for placenta localization, heart diseases examination, and for determination of blood volume; ^{131}I-labeled albumin microspheres; albumin microsphere-^{99m}Tc labeling kit; and albumin microsphere-^{113m}In labeling kit. (LK)

29163 HIPPURAN–^{131}I: OBSERVATIONS ON THE PURITY CONTROL OF IT. Belkas, E.; Hiotellis, E.; Dassiou, C. (Greek Atomic Energy Commission, Athens). pp 141-153 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

This year the production of Hippuran-^{131}I was started and some problems on the quality control of this compound were faced. In the present paper the method used for the production of this radiopharmaceutical is described with special reference on the observations and on the difficulties confronted concerning its purity control. (auth)

29164 PYROGENIC CONTROL OF RADIOPHARMACEUTICALS. Dassiou, C. A. (Greek Atomic Energy Commission, Athens). pp 155-161 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Use of the pyrogenic test as a means of quality control for radiopharmaceuticals is discussed. (LK)

29165 RADIOPHARMACEUTICAL CONTROL AT THE BORIS KIDRIC INSTITUTE. Jovanovic, V.; Zmbov, B.; Cvoric, J.; Memedovic, T. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 163-178 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

The following methods of quality control of radiopharmaceuticals at Boris Kidric Institute are discussed: determination of radionuclide purity; determination of chemical purity; determination of radiochemical purity; and biological investigations. (LK)

29166 HISTORY OF RUTHENIUM STUDIES IN JAPAN BEFORE WORLD WAR II. Koda, Y. (Government Industrial Research Inst., Nagoya (Japan)). Kagaku No Ryoiki; 28: No. 3, 204-210(Mar 1974). (In Japanese).

Studies on ruthenium in Japan before the Pacific War are reviewed. Sir Ramsay reported at a chemical society in London in 1908 that Ogawa seemed to discover a new element "Nipponium" that has been called Tc at a later period. The formerly known sandy platinum of Hokkaido was found to be iridosmine that contained little Pt but some Ru and Rh, in about 1895. The iridosmine was exported to Germany until World War I. Thereafter, it has been used as an abrasion resisting alloy for fountain pens by electrodeposition. The quantitative separation of Ir from Pt family was made possible in 1923 by the discovery of volatility of RuO_4 produced when ruthenium was heated with HNO_3 in concentrated H_2SO_4 to the boiling point of H_2SO_4 acid. Radiochemical studies of ruthenium have developed since about 1941. A new radioactive isotope of ruthenium was found in fission products of uranium nuclei. Ruthenium was identified in the ashes of Hiroshima atomic bomb and the Fukuryu maru No. 5. These determinations were performed on the basis of newly established disintegration series, which is ascribable to careful chemical separation and the accurate measurement of attenuation studied by Nishina and Kimura. (JA)

29167 RADIOACTIVE KRYPTONATES [^{85}Kr]: THEIR PREPARATION, PROPERTIES, AND USES IN CHEMISTRY AND RELATED SCIENTIFIC AREAS. Toelgyessy, J. (Slovak Technical Univ., Bratislava); Varga, S.; Klehr, E. H. Radioisotopy; 15: No. 5, 623-803(1974).

A review is presented dealing with the preparation, properties, and uses of radioactive kryptonates with ^{85}Kr in chemistry and related scientific and technical areas. (227 references) (auth)

Radioactive Waste Treatment

Refer also to abstracts 30335 and 30346.

29168 (ANL-8152) CHEMICAL ENGINEERING DIVISION WASTE MANAGEMENT PROGRAMS. Quarterly Report, July–September 1974. Steindler, M. J.; Levitz, N. M.; Mecham, W. J.; Seefeldt, W. B.; Trevorrow, L. E.; Winsch, I. O.; Gerding, T. J.; Kullen, B. J.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-eng-38. 27p. Dep. NTIS $4.00.

Emphasis of work in the study of consolidation techniques for fuel-cladding hulls has shifted from review and evaluation of literature related to Zircaloy hulls to experimental work. Preparations are being made for scouting tests on a volatility scheme employing anhydrous HCl for separating the zirconium as the volatile tetrachloride. Promising results were obtained in initial studies of a pyrochemical approach using molten zinc chloride, to separate the zirconium as the tetrachloride. Acquisition of equipment and set-up of a facility are in progress for an initial program of studies on the salvage of alpha-contaminated metals by pyrochemical methods. A preliminary evaluation is presented of the technical and economic aspects of the application of hydrogen-water exchange to decontamination of low-level aqueous wastes from a fuel reprocessing plant. The application is based on recent improvements in catalyst efficiency and column design developed at the Institute for Stable Isotopes, Cluj, Romania. With regard to technical feasibility, the throughput capability and catalyst performance in the presence of trace contaminants in low-level aqueous waste are questioned. With regard to economic feasibility, the simplicity of design promises relatively low capital costs. Estimates of major operating costs are presented. For reduction of tritium concentration to 3×10^{-3} μCi/ml in preparation for environmental dispersal, the annual cost is 1.1×10^{-2} mills/kWh or $0.66/Ci retained. For reduction of the tritium concentration to 2 μCi/ml, in preparation for recycle to the fuel-reprocessing plant, the annual cost is 9.7×10^{-3} mills/kWh or $0.53/Ci retained. (auth)

29169 (BNWL-1893) RESEARCH AND DEVELOPMENT ACTIVITIES, WASTE FIXATION PROGRAM. Quarterly Progress Report, October–December 1974. McElroy, J. L. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-1830. 83p. Dep. NTIS $5.45.

Three engineering-scale tests and six laboratory tests of in-can melting were made. Experience from previous test melters and information from experts in the glass industry have been used to design a scale-model ceramic melter. Exploratory agglomeration tests were performed by Ferro-Tech Inc. using a simulated PW-4b spray calcined waste and -325 mesh 73-1 frit blend. Shakedown runs of the newly installed fluidized bed calciner were successfully completed, including testing of the combustion, feed, and off-gas systems. Experiments with the wiped film evaporator have established the feasibility of directly coupling the evaporator to a metallic-type melter to produce a borosilicate-type glass. The developmental spray calciner was operated for 39 hr to convert 711 liters of type PW-7a-2 simulated high-level waste to 135 liters of calcine. A series of laboratory-scale experiments has been completed showing the buildup of stored energy due to alpha particle emission in synthetic high-level waste incorporated in borosilicate glass. Helium diffusivity in simulated waste glass is

being examined with an electronic manometer system. A 310 stainless steel canister was cycled to canwall penetration by storage water. At Pennsylvania State University, a study was completed of the phases formed during firing of a simplified system containing the ten most abundant elements in PW-4b. A fault tree for risk analysis of waste shipment was constructed. (LK)

29170 (CEA-R-3663(1)) VOLATILITY OF RUTHENIUM DURING VITRIFICATION OPERATIONS ON FISSION PRODUCTS. Part 1. Distillation of Nitric Acid Solutions. Concentration of the Calcinates. Ortins de Bettencourt, A.; Jouan, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Direction des Materiaux et des Combustibles Nucleaires). Jan 1969. 44p. (In French). Dep. NTIS (US Sales Only) $5.25.

During vitrification of fission product solutions, a high percentage of the ruthenium initially present in these solutions in the form of nitrosylruthenium nitrates is volatized with the production of the peroxide which itself is decomposed to ruthenium dioxide. The aim of this work has been to study the volatility of the ruthenium during the vitrification processes. During the distillation of the nitric solutions, we have studied in particular the influence on the volatility of the temperature, chemical form in which the ruthenium is introduced, the bubbling of a gas through the solution, the nitric concentration and the nitrate concentration. During the calcination, we have observed the influence of the temperature, time, flow rate and nature of the carrier gas, as well as of the action of the ruthenium bioxide and the iron oxide on the volatility of the ruthenium. (auth)

29171 CONDENSOR AND SEPARATOR FOR SOLIDS FROM GAS MIXTURES. (to Stichting Reactor Centrum Nederland). Netherlands Patent 7,117,037. 13 Dec 1971. 6p. (In Dutch).

The invention provides a device for condensing and separating material in solid form from gas mixtures. (NL)

29172 PHYSICO-CHEMICAL PARAMETERS OF CONTROL AND OPTIMIZATION OF THE FLOCCULATION PROCESS IN RADIOACTIVE WATERS. Johannsen, K. H. Isotopenpraxis; 10: No. 11-12, 416-422(1974). (In German).

The flocculation of suspensoids from waste waters is performed with iron and aluminium salts. A series of processes not yet clarified in detail, as hydrolysis and sorption, leads to the formation of insoluble voluminous hydroxides which adsorb and incorporate the suspensoids. A brief description of some newer ideas of the flocculation mechanism is given. Some examination methods especially such for optimizing the flocculation process in routine operation are discussed. Examinations were performed in beakers with a serial stirring apparatus and primarily aimed at finding optimum flocculation conditions. (auth)

29173 RADIOACTIVE WASTE EMBEDDING BY THERMOSETTING RESINS. Cuaz, D.; Limongi, A.; Thiery, D. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service de Protection et des Etudes d'Environnement); Baer (Groupement pour les Activities Atomiques et Avancees (GAAA), 92 - Le Plessis-Robinson (France)). pp 769-786 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The principle of the process, consisting in the mixing of radioactive wastes with thermosetting resins, is described. The process takes place at room temperature and needs no heating at all. This process of embedding is usually applied to concentrates from evaporators after they have been dried, to ashes from incinerators, to cyclone powders, air-filter materials, ion-exchange resins, and organic solvents. The physical properties of the embedding are indicated as for resistance to irradiation, fire, lixiviation, and mechanical stress. The process is illustrated with applications to light water power reactors and compared to the more classical embedding by cement. (FR)

29174 METHODS OF PROTECTION AGAINST ENVIRONMENTAL CONTAMINATION BY RADIOACTIVE MATERIALS. Polyakov, A. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). pp 651-676 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The following topics are discussed: liquid and solid radioactive waste treatment; gaseous radioactive waste; tritium release; carbon-14 release; argon-41 release and trapping; krypton and xenon release and trapping; adsorption decontamination methods; trapping of radioactive iodine; decontamination of APS reactor gaseous waste from aerosols; characteristics of radiation conditions in neighbourhood of the APS reactor. (FR)

29175 MANAGEMENT OF FISSION PRODUCTS AND LONG-LIVED ALPHA WASTES. Olivier, J. P. (OECD Nuclear Energy Agency, Paris). Advan. Nucl. Sci. Technol.; 8: 141-172(1975).

This general review of high level waste management considers: the magnitude of the problem; the current situation in Europe and the U. S.; solidification techniques and final product characteristics; storage, disposal, and transportation of the solidified waste; and economic considerations. (LK)

29176 PROCESSING AND STORAGE OF RADIOACTIVE WASTES. Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergi GmbH, Seibersdorf). Umweltschutz-Staedterinigung; 9: No. 6, 123-126(Jun 1972). (In German).

Some methods for appropriate removal of radioactive wastes are described. Combustion processes are used for solid wastes; and dilution, decay, ion exchange, chemical separation and evaporation processes are used for liquid wastes. Adsorption on activated carbon is mentioned as a possible treatment for radioactive offgases. (tr-auth)

29177 CHEMICAL TREATMENT AND CEMENT FIXATION OF RADIOACTIVE WASTES. Christenson, C. W.; Emelity, L. A. (Los Alamos Scientific Lab., NM). J. Water Pollut. Contr. Fed.; No. 7, 1343-1350(Jul 1970).

From 42nd annual conference of the Water Pollution Control Federation; Dallas, TX (5 Oct 1969).

Methods for treating radioactive wastes at LASL are discussed. Schematics of the processes used for treating the main waste stream and for cement fixation of radioactive slurries are included. Treatment of batch wastes is also considered. (LK)

Radioisotope Production

Refer also to abstracts 29064, 30396–30398, 31517, and 31566.

29178 (CEA-CONF-2758) PRODUCTION OF AND MEDICAL INTEREST IN THE RADIOISOTOPES ^{11}C, ^{13}N, ^{15}O, and ^{18}F. Comar, D.; Crouzel, C.; Kellershohn, C. (CEA, 91-Orsay (France). Service Hospitalier Frederic Joliot). [nd]. 27p. (In French). (CONF-740691-1). Dep. NTIS (US Sales Only) $4.50.

From 16th French colloquium of nuclear medicine; Clermont-Ferrand, France (6 Jun 1974).

The installation of cyclotrons at hospitals has permitted the development of new diagnostic methods using short-lived radioisotopes such as ^{11}C (T = 20.4 min), ^{13}N (T = 10 min), ^{15}O (T = 2.05 min), and ^{18}F (T = 1.84 hr). These four positron emitters and therefore emitters of two γ rays at 511 keV by decay are particularly well adapted to external detection. Because of their short lifetime the radioactive concentration per mass unit is very high. Several aspects of their production and incorporation into simple or complex molecules are described. (tr-auth)

29179 SEPARATION OF CARRIER-FREE RADIOACTIVE RARE EARTHS BY GAS CHROMATOGRAPHY OF THEIR CHELATE COMPOUNDS. Herrmann, E.; Beyer, G. J.; John, M. (Technische Universitaet, Dresden). Isotopenpraxis; 10: No. 11-12, 411-413(1974). (In German).

A gas chromatographic method is reported for the separation of the carrier-free radioactive lanthanides. Gas chromatograms of mixtures of the Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu chelates to pivaloyltrifluoracetone (PTA) were obtained, if the carrier gas contains an excess of PTA. The mean separation factor for the heavy lanthanides is 1.4. (auth)

29180 RECOVERY AND PURIFICATION OF ^{231}Pa BY ANION EXCHANGE. Jenkins, I. L.; Scargill, D.; Wain, A. G. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Inorg. Nucl. Chem.; 37: No. 1, 257-259(Jan 1975).

The purification of ca. 35 g of ^{231}Pa by anion exchange in hydrofluoric acid medium is described. Protactinium recoveries of >99% are obtained and very good purification from silica and niobium in particular is achieved if fresh resin is used for each run. (auth)

29181 SEPARATION OF ^{227}Ac PRODUCED IN ^{226}Ra NEUTRON IRRADIATION. Boue-Ruelle, F.; Bouissieres, G.; David, F.; Legoux, Y.; Muxart, R.; Rogelet, P.; Zuppiroli, G. (Paris-11 Univ., 91 - Orsay (France). Div. de Radiochimie). Rev. Chim. Miner.; 11: No. 4, 466-473(1974). (In French).

Separation of ^{227}Ac and ^{228}Th from 120 mg of ^{226}Ra irradiated by thermal neutrons is performed by selective amalgamation

of radium and actinium. In the presence of 0.1 M cesium citrate, only radium is amalgamated by three successive electrolyses with a total decontamination factor of 10^{-5}; addition of lithium oxide to the citrate solution allows actinium separation with a 95% output, radium contamination being less than 0.3%; thorium is recovered from the final solution by coprecipitation with iron hydroxide. (FR)

29182 PROCEDURE FOR THE PRODUCTION OF RADIOACTIVE BARIUM-137m. Hirofumi, Arino; Reardon, V. D. (to Union Carbide Corp., New York (USA)). German(FRG) Patent 1,943,416/B/. 5 Jul 1973. 3p. (In German).

With this invention, a procedure for the production of Ba-137m with high yield and high purity is proposed. The isotope generator consists of a ferrocyanide substrate charged with the Cs-137 mother nuclide and mixed with supplementary filtration means. The daughter nuclide can be eluted by means of physiological salt solution or weak acidic solutions. (GE)

29183 GENERATOR SYSTEMS OF SHORT-LIVED RADIONUCLIDES. Mudrova, B.; Kopecky, P. (Ustav Jaderneho Vyzkum, Rez, Czech.). Radioisotopy; 15: No. 6, 913-957(1974). (In Czech).

A critical review (142 references) comprising a summary of the most relevant published data concerning the preparation and use of generator systems as sources of short-lived radionuclides and a draught of future development in this field, based on the knowledge of decay schemes and of the possibility of preparation and separation of the respective radionuclides is given. In total, 65 radioactive genetic pairs are discussed. (auth)

29184 RADIONUCLIDIC IMPURITIES IN $^{99}Mo-^{99m}Tc$, GENERATORS: THEIR MEASUREMENT AND IMPORTANCE. Husak, V. (Oddeleni Nuklearni Mediciny, Olomouc, Czech.); Kokta, L.; Vlcek, J.; Dvorak, V. Radioisotopy; 16: No. 1, 1-35 (1975). (In Czech).

The paper contains basic information on contaminating radionuclides in ^{99m}Tc eluates from $^{99}Mo-^{99m}Tc$ generators. Attention is paid to the wide-spread column chromatography method of ^{99m}Tc preparation, the extraction and sublimation methods are also mentioned. A simple method for the estimation of the additional radiation burden to examined persons due to contaminating radionuclides is described. A survey of admissible contaminant activities in eluates set by foreign and Czechoslovak regulations is presented. Methods for identification and activity measurement of contaminants in eluates before administration to patients and after ^{99m}Tc activity decay are discussed. The results of long termed follow-up of radionuclidic purity of imported generators and estimated values of the contribution from contaminants to the absorbed dose rate are presented. (auth)

29185 $^{82}Sr-^{82}Rb$ ISOTOPE GENERATOR FOR USE IN NUCLEAR MEDICINE. Grant, P. M.; Erdal, B. R.; O'Brien, H. A. Jr. (Univ. of New Mexico, Los Alamos). J. Nucl. Med.; 16: No. 4, 300-304(Apr 1975).

An improved $^{82}Sr-^{82}Rb$ generator system, based on the complexing ion-exchange resin Chelex-100, was developed. Columns of this material can be easily and rapidly milked, and the rubidium–strontium separation factor for a fresh generator under the experimental conditions studied was found to be $>10^7$. Approximately 80% of the ^{82}Rb present can be delivered in a 15-ml volume of aqueous 0.2 M NH_4Cl solution. After more than 6 liters of eluant had passed through the generator, the rubidium–strontium separation factor was still observed to be $>10^5$ and no unusual strontium breakthrough behavior was seen in the system over nearly three ^{82}Sr half-lives. (auth)

29186 RADIOISOTOPE PRODUCTION. Proceedings of the 5th European Meeting of Radioisotope Producers, Athens, Greece, November 27–29, 1974. Athens; Greek Atomic Energy Commission (1974). 186p. (CONF-741147-).

The 16 papers presented at the meeting were abstracted and indexed separately. (LK)

For abstracts of individual papers see: 29161–29165, 29187–29193, 30065, 30066, 30396, and 30397.

29187 PRODUCTION OF RADIONUCLIDES AND LABELLED COMPOUNDS AT THE RESEARCH CENTER SEIBERSDORF. Angelberger, P.; Burtscher, A. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna). pp 13-18 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Facilities for and production of radionuclides, sealed sources, labeled compounds, and radiopharmaceuticals at the Research Center Seibersdorf are discussed. The production method for ^{99m}Tc radiopharmaceuticals is given. (LK)

29188 RECENT PRODUCTION DEVELOPMENTS OF THE CIS ASSOCIATION. Fallais, C.; Constant, R. (Institut National des Radioelements, Fleurus, Belgium). pp 19-29 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974). (In French).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

The CEA-IRE-SORIN association or CIS was formed to respond to the needs of nuclear medicine. Its efforts have primarily been directed toward the development of techniques for the production of short-lived isotopes to be used in diagnostic studies and to the preparation of a series of kits for radioimmunological determinations in vitro. Both are briefly described. (JSR)

29189 PRESENT STATE AND DEVELOPMENT OF RADIOISOTOPE PRODUCTION IN CZECHOSLOVAKIA. Chorvat, K.; Vagner, J. (Inst. for Research, Production, and Application of Radioisotopes, Prague). pp 31-41 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Production of ^{14}C and tritium labeled organic compounds, sealed sources, standards, and radiopharmaceuticals is discussed. ^{14}C and tritium labeled organic compounds that are produced exclusively by the Institute for Research, Production and Application of Radioisotopes are listed. (LK)

29190 RECENT DEVELOPMENTS IN THE PRODUCTION OF RADIOISOTOPES IN HUNGARY. Lengyel, T. (Inst. of Isotopes, Budapest). pp 43-47 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Developments in radioisotope production from 1972 to 1974 are discussed. Production method for ^{131}I from a magnesium tellurate target is given. Changes in ^{99m}Tc radioisotope generators are given. (LK)

29191 RADIOISOTOPE PRODUCTION AT THE BORIS KIDRIC INSTITUTE. Teofilovski, C.; Jovanovic, O. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 73-88 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Irradiation of materials, laboratory space and instruments; and latest results and future plans at the Boris Kidric Institute are discussed. (LK)

29192 RADIOISOTOPE PRODUCTION IN FINLAND. Uhlenius, R. (Technical Research Centre of Finland, Otaniemi). pp 89-91 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Radioisotope production in Finland is reviewed. Their main product is ^{131}I; hippuran-^{131}I is also produced. (LK)

29193 CYCLOTRON PRODUCTION OF CARRIER-FREE ^{67}Ga. Frangopol, M.; Pencea, C.; Calboreanu, A.; Frangopol, P. T.; Cincu, E.; Manzatu, I.; Papae, D. (Institutul de Fizica Atomica, Bucharest). pp 103-117 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Gallium-67 for medical applications is produced in the cyclotron from the reaction $^{65}Cu(\alpha,2n)^{67}Ga$. The results of yield measurements of ^{67}Ga as well as of ^{66}Ga, the main radionuclidic impurity, are reported, and an irradiation method to improve the $^{67}Ga/^{66}Ga$ ratio is suggested. The procedure of chemical separation is outlined. A chemical separation yield of 85% is routinely obtained. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 28983, 29575, and 32297.

29194 (ANL-8139) MANAGEMENT OF WASTE CLADDING HULLS. Part I. Pyrophoricity and Compaction. Levitz, N. M.; Kullen, B. J.; Steindler, M. J. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-eng-38. 57p. Dep. NTIS $5.45.

Two phases are presented of a study on the problems related to the long-term management of Zircaloy cladding hulls: (1) an assessment of the pyrophoricity hazard and (2) an evaluation of mechanical compaction as a means of consolidating the waste hulls. Information is presented on the physical characteristics of the waste, current and proposed methods for the handling of

the waste, the pyrophoricity of zirconium and its relationship to waste handling, mechanical compaction, and irradiation induced property changes of Zircaloy. (auth)

29195 (CEA-CONF-2903) UTILISATION OF HYDROXYLAMINE NITRATE FOR THE FINAL CONCENTRATION AND PURIFICATION OF PLUTONIUM IN THE IRRADIATED FUEL PROCESSING FACTORY AT LA HAGUE. Patigny, P.; Regnier, J.; Miquel, P.; Taillard, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); CEA Centre de La Hague, 50-Cherbourg (France)). [nd]. 19p. (CONF-740917-10). Dep. NTIS (US Sales Only) $4.00.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Tests are described to show that a simple extraction-re-extraction process using hydroxylamine nitrate and tributyl phosphate can enable plutonium to be concentrated and purified suitably in the third cycle normally used in the irradiated fuel processing factories. It emerges that this reducing agent must not be employed in too large an amount in relation to the plutonium and the acidity in re-extraction must not be too high. The increase in temperature and the presence of hydrazine are favourable to its action. The plutonium reducing re-extraction technique with hydrazine nitrate is compared with those using uranous nitrate or electrolysis in terms of performance and economy. Nevertheless it forms part of the techniques which make it possible to envisage an irradiated fuel processing process using only one solvent (TBP) and clean reagents compatible with the nitric medium. (auth)

29196 (CEA-CONF-2906) ADAPTATION OF THE PUREX PROCESS TO THE REPROCESSING OF FAST REACTOR FUELS. Boudry, J. C.; Miquel, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Div. de Chimie; CEA Centre de La Hague, 50-Cherbourg (France)). [nd]. 19p. (CONF-740917-5). Dep. NTIS (US Sales Only) $4.00.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

The increase in the fission product content of the highly irradiated fuels tends to reduce the TBP selectivity with respect to the extraction plutonium nitrate and uranyl nitrate. Some new improvements are required in such areas as the feed clarification, the liquid-liquid contactors and the process chemistry. Small amounts of hydrogen fluoride (HF) were added in the first extraction feed to eliminate the very bad effects due to the zirconium. This process has been in use since 1968 for the reprocessing of metallic fuels in the Marcoule plant. It has been successfully adapted for the reprocessing of fast reactor fuels irradiated up to 80,000 MWd/t in the AT.1 pilot plant at La Hague. (auth)

29197 (CEA-CONF-2908) USE OF FORMIC ACID FOR THE STRIPPING OF PLUTONIUM. Germain, M.; Bathellier, A.; Berard, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). [nd]. 28p. (CONF-740917-8). Dep. NTIS (US Sales Only) $4.50.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A new extraction process is proposed in which the stripping of plutonium is realized by a mixture of formic acid and nitric acid. When high concentration of plutonium and/or high concentration factors are required, an alternative process which combines the complexing action of formic acid and the reducing properties of hydroxylamine is used. The processes were tested successfully at the laboratory scale in the conditions of the final purification of plutonium as well as those of the partition of uranium-plutonium. The formic solutions of plutonium can then either be boiled to destroy formic acid and increase plutonium concentration or the plutonium is precipitated as solid compound. (auth)

29198 (DP-1376) DECONTAMINATION OF DISSOLVED U-Al FUEL BY SIMULTANEOUS TREATMENT WITH GELATIN AND MnO_2. Harmon, H. D. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Mar 1975. Contract AT(07-2)-1. 13p. Dep. NTIS $4.00.

The method of decontaminating enriched U-Al fuel solutions from fission products by simultaneous treatment with gelatin and MnO_2 was investigated to determine the effects of $Al(NO_3)_3$ and HNO_3 concentrations and to optimize operating conditions. Heating at 70 to 80°C after $KMnO_4$ addition for differing periods of time had no significant effect on cake volume or the decontamination factor (DF). Cake volume and DF both decreased markedly with increased HNO_3 and $Al(NO_3)_3$ concentrations. The decreased particle size associated with the small cake volumes at high $Al(NO_3)_3$ concentrations is a potential cause of problems in filtration and centrifugation of the cake. To achieve adequate decontamination and efficient cake removal, HNO_3 and $Al(NO_3)_3$ should be adjusted to <1M before the gelatin-MnO_2 treatment and concentration of the feed for solvent extraction should be performed after the strike. Retention of uranium, neptunium, and plutonium in the MnO_2-gelatin cake is decreased to acceptable levels by five washes with 0.1M HNO_3. (auth)

29199 (ORNL-5015) DISSOLUTION OF UNIRRADIATED AND IRRADIATED $(U,Pu)O_2$ IN NITRIC ACID. Goode, J. H.; Fitzgerald, C. L.; Vaughen, V. C. A. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 85p. AT.

Results obtained from laboratory and hot-cell studies designed to delineate the dissolution behavior of sol-gel, coprecipitated, and mechanically blended $(U,Pu)O_2$ in nitric acid are summarized. The completeness of dissolution of the plutonium is shown to be a function of the degree of solid solution formation between the UO_2 and PuO_2. The formation of a homogeneous solid solution is controlled by the fabrication method and irradiation conditions. Sintering during irradiation renders a nonhomogeneous fuel more soluble; however, complete solubility of such fuels may be ensured only if a dissolution promoter, such as fluoride ion, is added to the nitric acid dissolvent. Characterization studies of the noble-metal fission product residues are described. (auth)

29200 (ZFK-252) INVESTIGATION OF SUPPORT MATERIALS FOR EXTRACTION CHROMATOGRAPHY AND SEPARATION OF URANIUM, PLUTONIUM, AND FISSION PRODUCTS ON TRIBUTYLPHOSPHATE/POLYTETRAFLUOROETHYLENE COLUMNS. Hermann, A.; Huebener, S. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1973. 40p. (In German). Dep. NTIS (US Sales Only) $5.00.

Four chromatographic support materials from GDR firms, one polytetrafluoroethylene support from USSR, polytrifluorochlorethylene and Hyflo-Super-Cel were investigated for suitability under conditions of separation of uranium from other constituents of irradiated uranium fuel solutions with tributylphosphate as an extracting agent. Among the supports there is a new material developed in GDR on the basis of polytetrafluoroethylene with some favorable properties. The experimental results are discussed in connection with the problem of comparison criteria for columns with supports differing in chemical nature, particle size and other parameters. Reduced plate height and velocity were used to arrange experiments under comparable conditions. The results indicate the fluorocontaining supports to be the most suitable ones from the investigated materials for the considered separation problem. An extraction chromatographic method has been developed to separate plutonium and uranium from irradiated uranium fuel samples. Tributylphosphate fixed on polytetrafluoroethylene was used as stationary phase and HNO_3 of various concentrations as mobile phase. The separation of plutonium by reduction with H_2SO_3 was studied in column experiments. The method was applied to the separation of irradiated U/Mg-fuel with a Pu/U ratio of 1:400. (auth)

29201 DEVELOPMENT OF LABORATORY METHODS FOR DESTRUCTIVE RADIOCHEMICAL BURNUP ANALYSIS. Hermann, A.; Baraniak, L. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). July 1973. 58p. (In German). Dep. NTIS (US Sales Only) $6.00.

For the purpose of destructive burnup analysis of spent fuels by determining the fission product/U ratio, radiochemical methods were developed for the separation of Cs, determination of ^{144}Ce, separation of Ce, and determination of U. The Cs is separated from the irradiated fuel by ion exchange on ammonium phosphomolybdate. ^{144}Ce was determined by β counting after extraction with hexone. Di-(2-ethylhexyl) phosphoric acid was used to separate the Ce. U was determined by controlled-potential coulometric titration or spectrophotometrically with Arsenazo III. The specifications, advantages, and difficulties of each method are discussed in detail. (JSR)

29202 FUNCTIONAL MODEL EVALUATION AND PROCESS SIGNAL ANALYSIS. Petrich, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). KFK Nachr.; 6: No. 4, 9-11(1974). (In German).

Very frequently, the operator in a fuel reprocessing plant cannot be expected to be able to deduce the operational state of the system from the total of all measured values available. Therefore, a mathematical model of the process to be controlled is implemented in a process computer. The model is continuously synchronized with the real process by processing of the measured values and allows an optimum prediction of the probable process development. (GE)

29203 RADIOPROTECTION PROBLEMS RELATING TO STORAGE, DECANNING, AND DISASSEMBLING OF IRRADIATED FUEL ELEMENTS IN WATER POOLS. Chassany, J.; Gallissian, F.; Peyresblanques, H. (CEA Centre de Marcoule, 30 - Bagnols-

sur-Ceze (France). Service de Protection Contre les Radiations). pp 207-227 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

With regard to water pollution, ponds are classified in several categories. The steps to be taken in each case are described: covering, classification of access ways, surface aeration, water purification, protective measures, contamination of walls and objects taken out from water, etc. Data obtained on filtration and periodical decontamination of the walls are also given. New trends, taking into account the specific characteristics of fuel elements to be processed in the future as well as past experience, are defined. (FR)

29204 A METHOD FOR THE CONTINUOUS CONVERSION OF A HYDROXYLAMINE SALT TO ANOTHER HYDROXYLAMINE SALT. Demarthe, J. M.; Gue, J. P.; Grieneisen, A ; Miquel, P. (to CEA, 75 - Paris (France)). French Patent 2,206,270/A/. 16 Nov 1972. 7p. (In French).

The method comprises the steps of counter-current contacting the starting salt solution with a cationic solvent so as to extract the hydroxylamine cation, then re-extracting said hydroxylamine cation by counter-current methods contacting the thus charged solvent with an aqueous solution, the anion of which is that of the hydroxylamine salt to be obtained. This applies to the preparation of hydroxylamine nitrate on formate used as reducing agents in fuel reprocessing. (FR)

CONTROLLED THERMONUCLEAR RESEARCH

29205 (MATT-1(Suppl. 1)) BIBLIOGRAPHY OF PLASMA PHYSICS LABORATORY REPORTS AND PUBLICATIONS, 1971. 7th Edition. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Mar 1972. 11p. Dep. NTIS $4.00.

29206 (MATT-1(Suppl. 2)) BIBLIOGRAPHY OF PLASMA PHYSICS LABORATORY REPORTS AND PUBLICATIONS, 1972. 7th Edition. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Feb 1973. 13p. Dep. NTIS $4.00.

29207 (MATT-1(Suppl. 3)) BIBLIOGRAPHY OF PLASMA PHYSICS LABORATORY REPORTS AND PUBLICATIONS, 1973. 8th Edition. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Jan 1974. Contract AT(11-1)-3073. 12p. Dep. NTIS $4.00.

Plasma Confinement and Heating

Refer also to abstract 29283.

29208 (CEA-CONF-2914) POSSIBLE EXPLANATION OF THE RF-INDUCED PUMPOUT OBSERVED ON LOW-β-TORI. Canobbio, E. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1974. 9p. (CONF-740969-2). Dep. NTIS (U. S. Sales Only) $4.00.

From symposium on plasma heating in toroidal devices; Varenna, Italy (3 Sep 1974).

Anomalous plasma cross-field diffusion was observed during the heating phase in various large-power rf experiments including TTMP and ICRH. A loss-mechanism is proposed which is based on the existence of a new type of low-frequency parametric instability. This instability results from the interaction of a pump wave at frequency ω_0 and arbitrary wave number $\vec{K}_0$, with two ion-acoustic waves of frequency ω and $(\omega - \omega_0)$ respectively ($|\omega| < \omega_0$), both with wave length much larger than the ion Larmor radius (but shorter than the wave length of the pump). Such waves are strongly ion-Landau damped in an almost Maxwellian plasma in the absence of the pump. This instability seems to provide a plausible explanation of the losses observed in the TTMP case, and may also be relevant to the ICRH-experiment. (auth)

29209 (COO-2277-5) HIGH BETA CAPTURE AND MIRROR CONFINEMENT OF LASER PRODUCED PLASMAS. Semiannual Report, August 1, 1974–January 31, 1975. Haught, A. F.; Polk, D. H.; Woo, J. T.; Fader, W. J.; Tomlinson, R. G.; Jong, R. A.; Ard, W. B.; Mensing, A. E. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). Jan 1975. Contract AT(11-1)-2277. 95p. (UARL-R-953100-22). Dep. NTIS $5.45.

During the current report period, primary attention has been placed on the construction of the Laser-initiated Target Experiment (LITE) apparatus. The LITE plasma production and confinement system has been developed from an assemblage of component parts to a tested, operating, experimental facility. The feedback particle suspension system has been incorporated in the confinement chamber, debugged, and refined and is in routine use, suspending particles of up to 100μm diameter at the chamber center with a position jitter as small as ~20μm. Modifications have been made to improve the reproducibility of the laser pulse output, and the system now employs two direction laser irradiation giving good plasma symmetry even with particles as large as 80-100μm. Initial plasma production experiments have been carried out in the new system, and the prepulse and heating conditions established for the generation of 400-600 eV symmetric plasmas with greatly increased reproducibility. Diagnostic instrumentation used for these initial experiments involve charge collector probes, with the data recorded and analyzed by the on-line PDP-11 computer facility for plasma symmetry, total ionization, and energy. Additional diagnostics, including an electrostatic energy analyzer, microwave interferometer, and the heavy ion probe, under development in a cooperative program by Hickok et al at RPI, are being prepared for installation in the experiment chamber for use in the target plasma confinement investigations scheduled for the first part of the next report period. In a parallel effort, studies of the operating characteristics of the MATS III ion source obtained from the Lawrence Livermore Laboratory have been carried out, and the neutralizer, ion deflector, drift tube, and termination tank beam line components have been assembled as a neutral beam line test stand. The vapor spray heads for the neutralizer have been constructed and are ready for installation for beam neutralization investigations. As presently scheduled, the neutral beam development effort is being conducted to produce a 1A, 10 keV neutral hydrogen beam line for incorporation into the LITE facility in March for initial injection experiments during the later half of the next report period. These experiment chamber, plasma production, diagnostic instrumentation, and beam development results are discussed in Sections II of this report. Theoretical investigations have included further development of the multi-species Fokker-Planck code, calculations of the LITE plasma behavior using this code, and a simulation analysis of the plasma buildup. The ISOTIONS multi-species Fokker-Planck code developed at the Lawrence Livermore Laboratory was modified to eliminate certain numerical instabilities in the iteration scheme, to include the effects of background neutrals and wall reflux on the plasma decay, to incorporate terms modeling the plasma buildup by neutral injection, and to use energy dependent cross-sections averaged over the distribution function. Calculations with the modified code have been performed to determine the effects of the lithium component on the plasma decay, the impact of delayed neutral injection, and the possibility of instabilities occurring during the injection heating phase of the plasma development. A simulation analysis of the plasma buildup has been undertaken to examine the erosion or growth of the plasma boundary through the combined processes of ionization and charge exchange collisions with the beam and interaction with the background neutrals. A diffusive particle transport mechanism associated with the finite ion Larmor orbit size and important at beam energies below 40 keV has been identified through this analysis. (auth)

29210 (COO-2387-34) PLASMA HEATING AND LOSSES IN TOROIDAL MULTIPOLE FIELDS. Armentrout, C. J.; Barter, J. D.; Breun, R. A. (Wisconsin Univ., Madison (USA)). Sep 1974. Contract AT(11-1)-2387. 12p. Dep. NTIS $4.00.

The heating and loss of plasmas were studied in three pulsed, toroidal multipole devices; i.e., a large levitated octupole, a small supported octupole, and a very small supported quadrupole. Plasmas are produced by gun injection and heated by electron and ion cyclotron resonance heating and ohmic heating. Electron cyclotron heating rates have been measured over a wide range of parameters, and the results are in quantitative agreement with stochastic heating theory. Electron cyclotron resonance heating produces ions with energies larger than predicted by theory. With the addition of a toroidal field, ohmic heating gives densities as high as 10^{13} cm^{-3} in the toroidal quadrupole and 10^{12} cm^{-3} in the small octupole. Plasma losses for $n = 5 \times 10^9$ cm^{-3} plasmas are inferred from Langmuir probe and Fabry-Perot interferometer measurements, and measured with special striped collectors on the wall and rings. The loss to a levitated ring is measured using a modulated light beam telemeter. The confinement is better than Bohm but considerably worse than classical. Low frequency convective cells which are fixed in space are observed. These cells around the ring are diminished when a weak toroidal field is added, and loss collectors show a vastly reduced flux to the rings. Analysis of the spatial density profile shows features of B-independent diffusion. The confinement is sensitive to some kinds of dc field errors, but surprisingly insensitive to perturbations of the ac confining field. (auth)

29211 (MATT-1115) BEAM-DRIVEN TOKAMAK FUSION–FISSION HYBRID REACTORS. Jassby, D. L. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Mar 1975. 26p. (CONF-741237-1). Dep. NTIS $4.50.

From meeting on fusion-driven fission systems; Germantown, Maryland, USA (3 Dec 1974).

The conditions for maximizing neutron flux from a beam-driven tokamak plasma are derived. The evolution of fusion power density and Q in passing from purely beam-driven operation to purely thermonuclear operation is discussed. With 200-keV deuteron beams injected into a tritium target plasma, one obtains the same power density for $Q \sim 1$ conditions as in a thermal D-T reactor operating at considerably great B_t and temperature, and requiring an $n\tau$ many times larger. Fissile breeding rates and power productions are given for beam-driven fusion-fission hybrid reactors with plasma parameters $B_t = 50$ kG, $T_e = 6$ keV, $n\tau = 10^{13}$ cm^{-3}sec, $a_p = 1.1$ m, $P_f = 4.3$ W/cm^3, $Q = 1.2$. Relevant plasma physics problem areas are discussed. (auth))

29212 (MATT-1124) CALCULATED NEUTRAL BEAM DEPOSITION AND VELOCITY SPACE LOSS REGIONS FOR THE PRINCETON LARGE TORUS. Smith, R. R. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Mar 1975. Contract AT(11-1)-3073. 24p. Dep. NTIS $4.25.

The radial profiles of hot ion birth rates for injection of H^0 and D^0 with energies of 20, 40, and 60 keV have been calculated for Princeton Large Torus (PLT). For tangential injection a centrally peaked hot ion birth profile requires a beam at least as penetrating as 40 keV H^0. Somewhat more peaked deposition is possible with nearly perpendicular injection. The velocity space boundaries separating confined drift orbits and lost drift orbits are shown. H^+ ions launched near the magnetic axis with an energy of approximately 0.5 MeV are confined, and the best confinement is at major radii somewhat smaller than the magnetic axis. Significant confinement of α particles from D-T reactions or T particles from D-D reactions is predicted. (auth)

29213 (ORNL-TM-4852) EFFECT OF IMPURITIES ON RF LOWER HYBRID HEATING OF A TOKAMAK PLASMA. Kritz, A. H.; Eldridge, O. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 30p. Dep. NTIS $4.50.

Variations in the peak electron density and in the impurity concentrations cause significant shifts in the location of the lower hybrid resonance for a given incident wave frequency. Moreover, small variations in the impurity concentration can result in violation of the accessibility condition. (auth)

29214 (TRITA-EPP-74-08) EXTERNAL RING SYSTEM FOR MAGNETIC PLASMA CONFINEMENT. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Feb 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

A new scheme for steady-state magnetic plasma confinement is suggested. The scheme consists of a superposition of two poloidal magnetic field components. The first arises from the unidirectional currents flowing in a number of ring-shaped external conductors. The second is produced by an oppositely directed azimuthal current in the plasma. Whenever necessary, an additional toroidal magnetic field component can be introduced. Preliminary considerations seem to indicate that this scheme provides a closed axisymmetric magnetic bottle with closed guiding-center drift orbits of the plasma particles, as well as possibilities of "bootstrap" operation. Short discussions are presented on the possibilities of stabilizing electrostatic modes by means of minimum-average-B geometry, and of stabilizing electromagnetic modes by means of the mutual forces between the currents in the plasma and those in the external conductors. This scheme differs from those having passive conductors surrounding the plasma in the sense that given currents are fed into the rings from external sources. (auth)

29215 (TRITA-EPP-74-17) RELAXATION TIMES OF PERMEABLE PLASMAS. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). 5 Sep 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

The particle and energy balance of plasmas being permeable to neutral gas is considered. There exist two subclasses of permeable plasmas. The first includes "dilute" plasmas being penetrated by slow neutrals of wall temperature. The second includes "non-dilute" plasmas being penetrated only by fast neutrals having a temperature comparable to that of the ions. The energy balance of dilute plasmas is strongly affected by plasma-neutral gas and plasma-wall interaction, as well as by the vacuum conditions, especially at long particle and energy containment times such as in the Spherator. Also the energy balance of non-dilute plasmas becomes affected by these interactions, but only to a limited extent in systems suffering from comparatively large losses such as Tokamaks. Earlier experiments with the Spherator can be explained by classical theory including plasma-neutral gas interaction, and need not be interpreted in terms of anomalous diffusion. Thus, the possibilities of the Spherator as a magnetic bottle have to be reconsidered. (auth)

29216 (UCID-16707) PROPERTIES OF PARTICLE ORBITS IN AN AVERAGE-MINIMUM B ABSOLUTE VALUE MIRROR CONFIGURATION. Freis, R. P.; Moir, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1975. Contract W-7405-Eng-48. 24p. Dep. NTIS $4.25.

Calculations are presented of drift surfaces, particle orbits and J invariants ($J = \oint v_{||} ds$) for a particular mirror configuration. These quantities are interesting because the particles with small $\mu(\mu = mv_{\perp}^2/2B)$ have drift surfaces which are not single valued and have J quantities which to lowest order are not invariant and in fact oscillate. The class of mirror confinement configuration we treat is known as average-minimum |B| in which the field lines are curved away from the plasma in places and towards it in others, but on the average are curved away. This particular configuration is of interest because it would be technologically much easier to build than a baseball or Yin-Yang configuration. (auth)

29217 (UCRL-Trans-10819) PLASMA BUILDUP THROUGH IONIZATION OF AN INJECTED BEAM ON THE SECONDARY PLASMA CREATED BY IT. Bogdanov, G. F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1974. Translated from IAE-2366. 21p Dep. NTIS $4.25.

The cross-over current needed for the buildup of dense plasma is estimated taking into account the probability of capture of fast ions during ionization of the injected atoms in the secondary plasma. First, the cross-over current is considered with use of a plasma target created independently, then the dependence of the cross-over current on the density of the secondary plasma created by the beam itself was considered. The vacuum problem is discussed when the values of the injected current are high. It is shown that the flow of gas into the plasma may exceed by several times the injected stream of atoms, which virtually eliminates any vacuum problems for the plasma injectors and apparently ensures stabilization of the flute instability and of the instabilities associated with the presence of a positive derivative of the distribution function. (auth)

29218 FORMATION OF A NON-NEUTRAL RELATIVISTIC-ELECTRON-BEAM RING IN A TOROIDAL MAGNETIC FIELD. Mohri, A.; Masuzaki, M.; Tsuzuki, T.; Ikuta, K. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Phys. Rev. Lett. 34: No. 10, 574-577 (10 Mar 1975).

A quiescent equilibrium state of a non-neutral beam ring may have been realized when a relativistic electron beam (450 keV, 16 kA, 2 nsec) was injected parallel to a toroidal magnetic field in vacuum. The longest lifetime obtained was 20 μsec which corresponded to 3000 revolutions of the electrons around the torus. The lifetime was limited by the appearance of an ion-resonance instability. (auth)

29219 COLLECTIVE INTERACTION OF RELATIVISTIC ELECTRON BEAM WITH A DENSE PLASMA. Kiselev, V.A.; Fainberg, Y.B.; Berezin, A.K. (Physico-technical Institute, Ukrainian Academy of Sciences). JETP Lett. 20: No. 9, 276-277 (5 Nov 1974).

Results are presented of an experimental investigation of the collective interaction of a relativistic electron beam with a plasma of density from 10^{15} to 10^{17} cm^{-3}. The beam loses from 15 to 90% of the energy, depending on the plasma density. Emission in the wavelength region ~1 mm, as well as soft x radiation, was observed from the plasma following interaction of the plasma with a relativistic electron beam (auth)

29220 CO_2 LASER HEATING OF PLASMA COLUMNS IN A STEADY SOLENOID FIELD. Rutkowski, H.L.; Scudder, D.W.; Pietrzyk, Z.A.; Vlases, G.C. (Aerospace Research Laboratory, University of Washington, Seattle, Washington 98195). Appl. Phys. Lett. 26: No. 8, 421-423 (15 Apr 1975).

A 250-J CO_2 laser has been used to produce plasma columns 12-20 cm in length, 2-4 mm in diameter, from initially uniform neutral hydrogen in a steady solenoidal field up to 100 kG. Interferometric and spectroscopic measurements indicate densities and temperatures on the order of 100 eV and 5×10^{17} cm^{-3}, respectively The backward-going laser-driven wave normally present in laser breakdown has been eliminated by pulsed filling of the tube. (auth)

29221 TRANSFORMATION OF THE MAGNETIC ENERGY OF A ROTATING RELATIVISTIC BEAM INTO PLASMA ENERGY. Kapetanakos, C.A.; Black, W.M.; Striffler, C.D. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 26: No. 7, 368-370 (1 Apr 1975).

An intense rotating relativistic electron beam of energy 500 kV and current 40-50 kA is injected into neutral gas of pressure 200-700 mTorr, in the presence of an external magnetic field $B_0 \simeq 800$ G. It is observed that the ratio of the magnetic field on axis $\Delta B_z(r=0)$ to B_0 is $\Delta B_z(r=0)/B_0 \simeq 2.2$. The average magnetic energy density is about 2.5×10^{16} eV cm^{-3}. Spectroscopic results show that most of this energy is transferred to the plasma through Joule heating. (auth)

29222 LASER HEATING OF A DENSE PLASMA PINCH. Chapin, D.L.; Duderstadt, J.J. (Department of Nuclear Engineering, The University of Michigan, Ann Arbor, Michigan 48105). Phys. Fluids 18: No. 3, 325-331 (Mar 1975).

A single fluid, two-temperature, one-dimensional magnetohydrodynamic model has been developed to describe the properties of a linear pinch plasma heated by an axially directed laser beam. The coupling of the laser light energy with the pinch dynamics is studied in detail. The laser light absorption occurs primarily through the inverse bremsstrahlung process, but the effect of enhanced absorption for sufficiently intense lasers has also been studied. Results of the calculations show a strong interaction between the heating by radial compression (pinching) and heating by the laser beam. It was found that the most important considerations in obtaining efficient heating of the plasma are the time profiles of the laser pulse and the electric current. The results of the anomalous absorption studies indicate that the increased absorption can cause the electron and ion temperatures to decouple and may actually be detrimental to the efficient laser heating of dense pinch type plasmas. (auth)

29223 OBSERVATION OF IONS OF ~30-50 CHARGE IN A LASER PLASMA. Aglitskii, E.V.; Boiko, V.A.; Krokhin, O.N.; Pikuz,

S.A.; Faenov, A.Y. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 9, 1152-1153 (Mar 1975).

Spectroscopic methods were used to detect Y, Zr, Nb, Mo, Ta, and W ions of charge ~30–50 in a laser plasma interacting with a laser beam of 5×10^{14} W/cm^2 density. Spectra of neonlike ions $Y^{29+}{}_{39}$, $Zr^{30+}{}_{40}$, $Nb^{31+}{}_{41}$, and $Mo^{32+}{}_{42}$ were identified. The presence of Ta and W lines in the 0.55–0.60 nm range yielded the ionization potential of ~4.2–5.2 keV, which corresponded to an ionic charge from 48 to 54. The intensities of the spectral lines were used to estimate the total number of ions created by one laser pulse and this number was at least 10^{11}. (auth)

29224 GENERATION OF DEUTERIUM–TRITIUM NEUTRONS BY SPHERICAL HEATING OF A SOLID TARGET WITH HIGH–POWER LASER RADIATION. Basov, N.G.; Zakharenkov, Y.A.; Krokhin, O.N.; Mikhailov, Y.A.; Sklizkov, G.V.; Fedotov, S.I. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 9, 1154-1155 (Mar 1975).

The results are given of time–of–flight measurements of the spectrum of neutrons generated by spherical heating of a $(CD_2)_n$ target by the radiation of a nine–channel laser unit. It is reported that neutrons corresponding to the reaction D(t, n)He^4 are generated in the laser plasma. A method is suggested for the determination of the degree of compression of the plasma from the numbers of the DT and DD neutrons formed in the plasma. (auth)

29225 RESONANCE ZONE EFFECTS ON ELECTRON HEATING OF AN ELECTRON-CYCLOTRON-RESONANCE PLASMA. Bernhardi, K.; Fuchs, G.; Goldman, M. A.; Herbert, H. C.; Obermann, D.; Walcher, W. (Marburg Univ. (F. R. Germany). Fachbereich Physik); Wiesemann, K. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik). Phys. Lett., A; 50: No. 5, 324-326(30 Dec 1974).

The influence of higher harmonic heating was examined in a microwave electron-cyclotron-resonance (ECR) plasma as the first resonance zone surface was partially withdrawn from the plasma. Harmonic heating did not appear to be appreciable. (auth)

29226 LASER FUSION. de Kluiver, H. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Atoomenergie Haar Toepass.; 16: No. 12, 273-280(Dec 1974). (In Dutch).

The production of intense lasers from various sources — ruby, glass, CO_2 and other gases — is described. A closed loop cycle shown diagrammatically shows the principle of obtaining hydrocarbons directly through the cycle laser–compression heating–thermonuclear reaction–reactor wall (output)–thermal heat (output)–turbine–laser. Developments in various countries are reviewed, with the U S timescale approximating to 1974–focussing; 1976–optical break-even, 10kJ; 1978–optical break-even, 100kJ; 1980–engineering break-even. Characteristics of implosions following the LASNIX code are shown for electron temp., pressure, velocity and fusion energy. Laser wavelength effects are also outlined. Energy equations for a laser fusion reactor are developed, with an example of typical values. (auth)

29227 APPRAISAL OF THE AVERAGE VELOCITY OF PENETRATION OF A THERMAL WAVE INTO PLASMA USING THE MODEL OF CONTINUOUS ABLATION OF THE OUTER LAYER. Kaliski, S. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 22: No. 7-8, 679-683(1974).

A formula is presented which appraises the averaged value of penetration of the velocity of heat induced by a laser pulse into a D-T pellet, for a model of continuous ablation of the outer layer. The formula constitutes a starting point for developing simplified averaged equations of laser compression of D-T plasma for the purpose of thermonuclear mico-fusion. The formula finds its application for descriptions where the model of continuous ablation and rejection of the outer layer constitutes a sufficient approximation. (auth)

29228 ELECTRIC FIELDS PARALLEL TO THE MAGNETIC FIELD IN A LABORATORY PLASMA IN A MAGNETIC MIRROR FIELD. Geller, R.; Hopfgarten, N.; Jacquot, B.; Jacquot, C. (CEN, Grenoble, France). J. Plasma Phys.; 12: 467-486(Dec 1974).

With electrostatic probes, the electric field component $E_\parallel$ along the magnetic field B was comprehensively investigated in a collisionless plasma, the density of which was of the order of 10^{10} cm^{-3}. The plasma in the experiment has several properties in common with the plasma of the ionosphere/magnetosphere scales to laboratory dimensions. The measurements show that a stationary $E_\parallel$ exists everywhere in the plasma, where the magnetic field gradient $\text{grad}_\parallel B$ in the direction of the field is different from zero. The direction of $E_\parallel$ is opposite to that of $\text{grad}_\parallel B$. The total potential drop along B between the resonance zone and the midplane of the mirror field is of the order of kilovolts. $E_\parallel$ accelerates ions along B to energies of the order of kilo electron volts. Experimental parameters of importance for the production of E are the neutral gas pressure p (normally a few times 10^{-5} torr), the microwave power (usually about 2 kW), and the mirror ratio γ in the mirror region opposite to the cavity side. γ was normally <2. For $\gamma > 2.3$, an instability develops and no stationary $E_\parallel$ remains. As p is increased, $E_\parallel$ decreases successively. In terms of the mean free path λ, it is found that $\lambda > 5-10L$ is a necessary condition for the existence of $E_\parallel$. L is twice the distance between the cavity and the midplane of the mirror field. In the experiment, the ion and electron pitch angle distributions are forced to be different; the ion velocity is mainly parallel to B, and the electron velocity essentially perpendicular to B, and as consequence $E_\parallel$ is created. In this way an experimental demonstration is presented of the theoretically predicted relation between $E_\parallel$ and the pitch angle distributions. When imposing sufficiently strong radial electric fields E_r (fields perpendicular to B), the distribution of the potential along B is deformed, probably due to changes in the particle distributions caused by E_r. The results support the idea that $E_\parallel$ is produced in the magnetosphere, and is at least sometimes an important mechanism for the acceleration and precipitation of auroral particles. (auth)

29229 ELECTRO-MAGNETIC EIGENMODES OF THE TOROIDAL CAVITY. Brambilla, M.; Finzi, U. (CEA, Grenoble, France). IEEE Trans. Plasma Sci.; PS-2: No. 3, 112-114(Sep 1974).

The eigenmodes of the empty toroidal cavity, relevant for hf heating of toroidal plasmas, are calculated using a development in the inverse aspect ratio. The eigensolutions are classified as quasi-TE and quasi-TH modes according to their cylindrical limit. Two exceptional modes are found for which both the electric and the magnetic field in the axial direction are nonzero already to the lowest order. The existence of these modes is connected with the accidental degeneracy of the cylindrical TH_1 and TE_0 modes. (auth)

29230 INJECTION OF INTENSE RELATIVISTIC ELECTRON BEAMS INTO A TOROIDAL GEOMETRY. Brower, D. F.; Kusse, B. R.; Meixel, G. D. Jr. (Cornell Univ., Ithaca, NY). IEEE Trans. Plasma Sci.; PS-2: No. 3, 193-195(Sep 1974).

Two experimentally verified methods are presented for the injection of high-current relativistic electron beams (30 kA, 400 kV) into strong toroidal magnetic fields (1 to 8 kGauss). Injection is accomplished by contouring the current flow in the stalk of a field-emission cathode to perturb the flux lines only during beam generation. On conclusion of the emission process the perturbed lines can return to their original positions thereby trapping the beam. (auth)

Plasma Diagnostics

29231 (AD-785842) FILTER AND FILM METHOD OF MEASURING THE TEMPERATURE OF A HOT, DENSE, LOW-Z PLASMA FROM ITS QUANTUM BREMSSTRAHLUNG. Final Report. Gerber, K. A.; Logan, B. G. (Naval Research Lab., Washington, D. C. (USA)). 23 Jul 1974. 23p. (NRL-7775). NTIS $3.25.

Results of calculations of the total integrated x-ray quantum bremsstrahlung emission transmitted through absorbers of aluminum, copper and carbon (polyethylene) are presented for a range of plasma temperatures and absorber thickness for both ideal detectors and for film. Such information is useful in obtaining values for the electron temperature in a plasma from measurements of the x-ray continuum emission. (auth)

29232 (COO-2229-9) ION BEAM PROBE PLASMA DIAGNOSTIC SYSTEM. Annual Progress Report, 1 May 1974–31 January 1975. Jennings, W. C.; Connor, K. A.; Hickok, R. L. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). Jan 1975. Contract AT(11-1)-2229. 42p. Dep. NTIS $5.25.

Progress was made in the development of heavy ion beam probing techniques for making space and time resolved measurements in magnetically confined plasmas. The present analyzer/detector system has been calibrated for amplitude and phase measurements out to 100 kHz. A new amplifier system was designed to extend the frequency range of the measurements and the concept of coupling the feedback signal to the bottom plate of the analyzer was explored. In addition, a dual-gain analyzer for making current density measurements was designed and constructed. An investigation of a Kelvin-Helmholtz instability was performed, leading to an unambiguous identification of the mode. A parametric study shows that the instability characteristics are mainly determined by the internal electric fields of the plasma. A normal mode analysis for comparing theoretical and experimental results is in progress. Data handling capabilities were

improved with the installation of a dedicated minicomputer, further work on a buffer storage system, and the design of an interface system for direct access to the computer. The measurements required for determining current density distributions are now well understood and work is continuing on the extraction procedure. A plasma system with sufficient current to make the measurements practical is required. Finally, a small Tokamak facility is being designed for the continued development of beam probing techniques. (auth)

29233 (EUR-CEA-FC-752) INCOHERENT LIGHT SCATTERING FROM HIGH TEMPERATURE PLASMAS. Mattioli, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1974. 32p. Dep. NTIS (U. S. Sales Only) $4.75.

The theory of incoherent light scattering from the electrons of a high-temperature plasma is considered without the usual limitation to terms of the first order in $\beta = v/c$. The correction due to the finite transit time of the electrons in the laser beam is included. An analytic expression is obtained for the scattered spectrum, this fact will facilitate the comparison between the theoretical and the experimental spectra to deduce the electron temperature. The influence of the finite transit time on the scattered spectrum should be observable for electron temperatures higher than 10 keV. (auth)

29234 (NP-20330) SYNCHROTRON RADIATION OF "RUN AWAY" ELECTRONS ON TOKAMAK TM-3. Vlasenkov, V. S.; Larionov, M. M.; Rozhdestvenskii, V. V. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1974. 10p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Measurements of the radiation plasma temperature in 4 and 8-mm wavelength bands on tokamak TM-3 are described. Nonthermal radiation with temperatures approximately equal to 10 keV was measured. Nonthermal radiation is synchrotron radiation of "runaway" electrons. Their properties were considered. On the base of data obtained, parameters of the "runaway" electron were estimated. (auth)

29235 (NP-20336) ELECTRON CONCENTRATION MEASUREMENT IN THE ARC OF THE ION SOURCE OF A DUOPLASMATRON TYPE. Abroyan, M. A.; Kagan, Yu. M.; Kolokolov, N. B.; Lavrov, B. P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Electron density measurements in hydrogen plasma in the duoplasmatron ion source according to Stark broadening of the spectral line H_β are described. The loops were measured by a Fabry-Perot interferometer in connection with a diffraction monochromator. Wavelength scanning was carried out by inclination angle changing of the interferometer. The apparatus loop was experimentally determined. (auth)

29236 TEMPERATURE DETERMINATION IN HIGH-PRESSURE SODIUM DISCHARGES BY DETECTION OF RF THERMAL NOISE. Anderson, J.M. (General Electric Research and Development Center, Schenectady, New York 12301). J. Appl. Phys. 46: No. 4, 1531-1534 (Apr 1975).

The electron temperature on the central axis of a discharge established in a mixture of sodium, mercury, and xenon gases at about 600 Torr pressure was measured by detection of radio-frequency thermal noise. The deduced value of 4200 °K compares favorably with determinations by spectroscopic methods and theoretical calculations. (auth)

29237 ESTIMATE OF THE RADIAL POTENTIAL JUMP IN A THETA-PINCH. Commisso, R.J.; Kunze, H. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Fluids 18: No. 3, 392-394 (Mar 1975).

A method for estimating the radial jump of the plasma potential associated with the piston in a theta-pinch is described. Small amounts of impurity atoms with different masses are added to the filling gas, and from spectroscopic measurements it is determined if they are picked up by the piston. (auth)

29238 INTERACTION OF TEA CO_2 LASER LIGHT WITH PLASMA. Yamabe, C.; Setoyama, E.; Yokoyama, M.; Yamanaka, C. (Osaka Univ. (Japan)). Phys. Lett., A; 50: No. 5, 349-350 (30 Dec 1974).

High power double discharge type TEA CO_2 laser was used to study laser plasma interaction on carbon target plasma. The maximum output power was 0.3 GW and full width at half maximum intensity was 100 ns. The reflectivity of the laser light was measured at 10.6 μm in wavelength from the carbon plasma. The reflectivity showed a maximum (~56%) at the laser power intensity of about 1.1×10^{10} W/cm^2, and at above this value, the reflectivity decreased. The absorption was introduced effectively above this intensity. The electron density and temperature were also measured. (auth)

29239 MASS SPECTROMETRY INVESTIGATIONS ON PLASMA BOUNDARY LAYERS. Henrich, K. (Bonn Univ. (F. R. Germany). Physikalisches Inst.); Mueller, K. G. (Essen Univ. (Gesamthochschule) (F. R. Germany)). Z. Naturforsch., a; 29: No. 9, 1276-1283(Sep 1974). (In German).

A description is given of measurements with a mass spectrometer on the positive ions and neutral gas of argon plasmas at 0.1 - 0.6 Torr. The adaption of the mass spectrometer to the plasma requires extraction probe and ion optics for imaging and burching of the charge carrier flow towards the mass spectrometer entrance. Equations are given and numerical calculations are carried out for proper dimensioning of the ion optics and to describe the ion path. The systematical measurement of the energy distributions of the individual ion types shows: 1) The BOHM criterion is confirmed. The ions are heated up to electron temperature in the transition zone of the boundary layer and are accelerated in the space-charge zone. 2) The heating-up and acceleration of the ions increases with the growing stream of ions to the extraction probe. 3) With a further increase of the probe currents, collisions start to occur in the space-charge zone of the boundary layer. According to measurements, Ar_2^+ collisions begin sooner than Ar^+ which is mainly present. This result implies a larger collision cross-section for the Ar_2^+ ions. 4) The H_3O^+ contained in small concentration in the plasma still cross the layer in this parameter range free of collision even at high ion accelerating voltages. 5) A simple measurement of the flow of an ion type in dependence of the probe current is well suited as an experimental method of answering the question of whether these ions collide in the boundary layer. (auth)

29240 SINGLE-FREQUENCY GAS LASERS FOR PLASMA DIAGNOSIS. Dushin, L. A.; Ostapchenko, E. P.; Privezentsev, V. I.; Teselkin, V. V. pp 272-277 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of the possibility of creating highly stable single-frequency lasers for interference methods of plasma research. He-Ne lasers emitting on wavelengths of 0.63, 1.15, and 3.39 μm were examined. Emission frequency instability of the order of 10^{-9} was achieved over a protracted period of laser operation on wavelengths of 0.63 and 1.15 μm. On $\lambda = 3.39\ \mu$m the long-term instability achieved was 5×10^{-10}, which can be appreciably reduced when a standard has been made based on nonlinear absorption of infrared radiation in methane. (Referativnyi Zh.)

29241 COMPARISON OF H_β THEORY AND EXPERIMENT AT ELECTRON DENSITIES NEAR 10^{15} cm^{-3}. Evans, D. L. (Arizona State Univ., Temple); Aeschliman, D. P.; Hill, R. A. Phys. Rev., A; 10: No. 6, 2430-2440(Dec 1974).

Theoretical H_β profiles by Vidal, Cooper, and Smith (VCS) and by Kepple and Griem (KG), convolved with the appropriate Doppler and instrument widths, have been compared to experimental H_β profiles obtained over the electron density range $4 \times 10^{14} \leq n_e \leq 2 \times 10^{15}$ cm^{-3}. The data were taken in a laminar argon plasmajet seeded with up to 1% H_2. Electron and atom temperatures were $\sim 8 \times 10^3$ and $\sim 6 \times 10^3$°K, respectively. Independent determinations of n_e were based on Stark-shift measurements of the 7273-Å Ar I line using a Fabry-Perot interferometer. Experimental H_β profiles were compared to theory by fitting the logarithms of the intensity by least squares while maintining profile area normalization to obtain "best-fit" values for n_e. A log fit effectively deweights the points near the line center, where the theoretical accuracy is poor, and thus, compared to a linear fit, yields n_e's in better agreement with the independently determined n_e's. For a given theory, no statistically significant difference was observed between values of n_e obtained using log-profile fitting and half-widths over the n_e range examined—for both methods, $n_e(H_\beta)/n_e$ (7273-Å Ar I) = 0.89 ± 0.20 and 0.80 ± 0.20 for VCS and KG theories, respectively. However, n_e's obtained using the two methods do not necessarily agree on a point-by-point basis. Finally, recent theoretical profiles including ion dynamic effects calculated by Cooper, Smith, and Vidal have been compared to our experimental profiles. Although improved agreement is noted in the vicinity of the line center (shallower theoretical dip-depth), the best-fit n_e's are ~10% lower than from VCS theory neglecting ion dynamics. (auth)

29242 PLASMA DIAGNOSTICS AND NONLINEAR WAVE STUDIES WITH A GRIDDED ELECTROSTATIC ENERGY ANALYZER. Mau, T. K. (Univ. of Wisconsin, Madison). IEEE Trans. Plasma Sci.; PS-2: No. 3, 152-159(Sep 1974).

A simplified theory relating the collector current to the grid bias and other plasma parameters has been developed for a multiple-gridded electrostatic energy analyzer. Experiments have shown that the theory is only approximately valid, but the temperature obtained agrees closely with that from a Langmuir probe. It is found that temperature measurements depend on the grid bias potentials and the ratios of grid hole radius to electron Debye

length. As a result, the conditions for the best performance of the energy analyzer as an accurate diagnostic device have been determined. A theory has also been worked out for the second-order change in the electron distribution function due to a cyclotron damped wave. This, together with experimental results, will provide valuable information on a thermal anisotropy of a plasma. (auth)

29243 RADIATION-TEMPERATURE REFERENCE LEVEL IN WAVEGUIDE PROBE MEASUREMENT OF ELECTRON PLASMA TEMPERATURE. Singer, A. (Johns Hopkins Univ., Baltimore); Minkowski, J. M. IEEE Trans. Plasma Sci.; PS-2: No. 3, 110-111(Sep 1974).

It is shown that the waveguide probe determinations of electron temperature of shock-heated plasma reported in the literature contain two errors. The major one is due to the use of an incorrect reference level for the plasma radiation temperature; the other is due to the use of an incorrect equation for relating the raw data to the electron plasma temperature. The effects of these errors are examined. (auth)

29244 MASS SPECTROMETRIC SAMPLING OF COMBUSTION PLASMAS. Hayhurst, A. N. (Univ., Sheffield, Eng.). IEEE Trans. Plasma Sci.; PS-2: No. 3, 115-121(Sep 1974).

From IUPAC symposium on plasma chemistry; Kiel, Ger. (6 Sep 1973)

An arrangement is described whereby atmospheric pressure flame plasmas are sampled into a quadrupole mass spectrometer for analysis and identification of each ion present. The principal difficulty encountered is that of obtaining a fully representative sample of gas without chemical reactions altering the composition. These problems are discussed in detail and it is concluded that only fast reactions, with relaxation times less than 1 μs, are capable of falsifying an ion spectrum. The ions present in combustion plasmas are described. Their kinetics of production by collisional and chemi-ionization processes, and recombination by both two- and three-body schemes are measured for various flame compositions and temperatures. In addition, cross sections are presented for reaction of H_3O^+ with various atoms and molecules, as well as for dissociative attachment of electrons to HCl. As examples of thermodynamic information resulting from this type of study the first hydration energies of a variety of positive ions are measured, as also are the ionization potentials of CaOH and SrOH. (auth)

29245 SINGLE WIRE MICROWAVE CONDUCTORS FOR DENSITY DIAGNOSTICS OF FLOWING ANISOTROPIC TRANSIENT PLASMAS. Cheung, A. Y.; Koopman, D. W. (Univ. of Maryland, College Park). IEEE Trans. Plasma Sci.; PS-2: No. 2, 67-70 (June 1974).

With a single wire conductor, microwave radiation can be guided through a plasma so that high spatial resolution (~0.5 cm) can be realized at X-band frequencies ($\lambda_0 \simeq 3$ cm). Dispersion relations for a single wire surrounded by a longitudinally magnetized plasma have been calculated. A Fabry-Perot single wire interferometer for measurements in magnetized flowing plasmas ($U \sim 10^7$ cm/sec) with a fast time resolution (~50 nanoseconds) has been built and calibrated, and used for electron density measurements. (auth)

Plasma Kinetics (General)

29246 (AD-784699) PULSED PLASMA ACCELERATORS. Kalmykov, A. A.; Leskov, L. V. 15 Aug 1974. Translated by C. T. Ostertag, Jr. from pp 183-191 of Plazmennye Uskoriteli, 1973. (FTD-MT-24-1072-74). 19p. NTIS $3.00.

29247 (CONF-750217-(Absts.)) 10TH AINSE PLASMA PHYSICS CONFERENCE, 10TH-11TH FEBRUARY 1975, LUCAS HEIGHTS, 12TH FEBRUARY 1975, UNIVERSITY OF SYDNEY. Abstracts of Papers. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). 1975. vp. (CONF-750218-(Abst.)).

Abstracts of papers of the 10th AINSE plasma physics conference are presented. The sessions were devoted to the following topics: 1) lasers; 2) plasma diagnostics; 3) discharge physics; 4) machines and CTR devices; 5) transport and collisional phenomena. (RL)

29248 (LA-5890-MS) INTRODUCTION TO EXPLOSIVE MAGNETIC FLUX COMPRESSION GENERATORS. Fowler, C. M.; Caird, R. S.; Garn, W. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1975. Contract W-7405-ENG-36. 31p. Dep. NTIS $4.00.

Various types of explosive flux compression generators are illustrated and their relative advantages are compared. Experiments are described in which energy was supplied by these generators. The experiments were selected to show both versatility and limitations of the devices. Generator principles are derived from lumped parameter circuit theory. (auth)

29249 (NP-20329) RESONANCE MICROWAVE BREAKDOWN IN A TOROIDAL MAGNETIC FIELD. Anisimov, A. I.; Vinogradov, N. I.; Poloskin, B. P. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1975. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Some experimental results on microwave breakdown in a toroidal chamber under electron cyclotron resonance conditions are reported. The balance of particles is considered in the single-particle approximation. It is shown that experimental and calculated data coincide if the energy gained by the electrons in the resonance region is determined by a relativistic change in cyclotron frequency. (auth)

29250 (PR-28) WILLS PLASMA PHYSICS DEPARTMENT TWENTY-EIGHTH 6-MONTHLY PROGRESS REPORT, 1 JULY-31 DECEMBER, 1974. (Sydney Univ. (Australia). School of Physics). 1974. 11p. Dep. NTIS (U. S. Sales Only) $4.00.

Progress is reported on several research programs which include: 1) plasma sources, 2) hydromagnetic shock waves, 3) rotating plasmas, 4) icr heating and magnetoacoustic heating, 5) carbon dioxide laser interferometer, 6) dye lasers, and 7) plasma-scanned Michelson interferometer. (RL)

29251 (UCID-16689) EFFECTS OF SYNCHROTRON RADIATION ON THE COMPRESSION OF A RELATIVISTIC ELECTRON LAYER. Nowak, D. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1975. Contract W-7405-Eng-48. 22p. Dep. NTIS $4.25.

The effect of a changing magnetic field on the equilibrium properties of an infinite electron layer is discussed. It is shown that the change in the total energy of the e-layer induced by a changing magnetic field is proportional to the change in the field, if the time scale for the change in the magnetic field is small compared to that for energy loss due to synchrotron radiation. Thus, in principle, it is possible to increase the total energy of an e-layer system by increasing the background magnetic field. The resulting system can be used as an intense source of relativistic electrons of total energy many times the initial e-layer energy. It also provides an intense synchrotron radiation source in the keV range. The change in the field can be induced by compressing a metallic liner enclosing the e-layer or, through the use of a capacitor bank or similar device to increase the background magnetic field. The former has the advantage of confining the magnetic field to the neighborhood of the electron layer. (auth)

29252 (UCRL-13620) TEMPORAL MEASUREMENTS OF THE ELECTRON DENSITY IN HIGH-PRESSURE ELECTRON-BEAM EXCITED XENON PLASMAS. Zamir, E.; Werner, C. W.; Lapatovich, W. P.; George, E. V. (Massachusetts Inst. of Tech., Cambridge (USA)). Mar 1975. Contract DAAB07-74-C-0630. 13p. Dep. NTIS $4.00.

The temporal evolution of electron density in high-pressure (50 to 400 psia) rare gases was measured. The measurements were carried out in a relativistic e-beam produced plasma by monitoring the absorption of a CO_2 laser passing through the medium. Comparison of experimental results with a theoretical model yields a room temperature rate coefficient of 1.5×10^{-10} cm^3/sec for the Penning ionization of excimers in xenon. (auth)

29253 (UCRL-51735) PROJECTION-TUBE STUDIES OF VOLTAGE-BREAKDOWN ARC DISCHARGES FROM TUNGSTEN AND NIOBIUM WIRES IN VACUUM. Miley, G. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jan 1975. Contract W-7405-Eng-48. 11p. Dep. NTIS $4.00.

The formation of "voltage breakdown" electric discharge arcs in vacuum between a wire cathode and a surrounding cylindrical anode has been studied with emphasis on behavior at the wire surface. Tungsten and niobium wires 2 to 10 mils in diameter were studied, using voltages up to 150 kV. Conditioning of the wire by heating was found to have a strong effect on the behavior leading to breakdown. With unconditioned wire, very high pre-breakdown currents were observed, and final breakdown occurred at low voltage. With partially conditioned wire (baked 1 hr at 800°C), low pre-breakdown currents characteristic of field emission were observed. With further conditioning of the wire (baking overnight), no significant pre-breakdown emission occurred before final breakdown. Based on these observations, a breakdown correlation is proposed for design purposes that involves three distinct regimes—initial, field emission, and ultimate—depending on prior conditioning of the surface. With a projection tube used as the cylindrical anode, phosphorescent patterns on the tube caused by the discharges were recorded with a high-speed camera, and the corresponding areas of the wire were studied with an electron microscope. Areas of the wire surface where pre-breakdown discharges occurred were found to be marked by

micron-sized condensed droplets of aluminum and silicate, evidently transported there from the anode surface in plasma form during the discharge. Often these droplets were condensed on the ends of whiskers of wire material pulled up from the wire surface in a pre-breakdown discharge. The final discharge appears to be a number of simultaneous arcs, each originating in an area of dense whisker formation on the wire surface. (auth)

29254 POLARITY EFFECTS IN HIGH-PRESSURE *z* PINCH. Preston, J.M.; Curzon, F.L. (Physics Department, University of British Columbia, Vancouver, British Columbia V6T 1W5, Canada). Appl. Phys. Lett. 26: No. 8, 417-418 (15 Apr 1975).

Significant differences in the electron density and temperature of the pinching plasma in a *z* pinch in helium are caused simply by reversing the polarity of the applied voltage. These effects are attributed to differences in the breakdown mechanism. (auth)

29255 AMPLIFICATION OF X-RAY RADIATION IN A DECAYING PLASMA USING TRANSITIONS IN HELIUM LIKE IONS. Gudzenko, L.I.; Evstigneev, V.V.; Yakovlenko, S.I. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 9, 1148-1148 (Mar 1975).

A demonstration is given of the technical possibility of x-ray amplification in a decaying dense plasma. Recombination in the ground state and accumulation of heliumlike ions in a metastable state should ensure an effective amplification in the presence of an additional long-wavelength radiation. (auth)

29256 ELECTRON-BEAM EXCITED CROSSED-FIELD DISCHARGE. Saenko, V. A.; Kasumov, M. M. (Inst. of Nuclear Research, Kiev). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 759-761(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1206-1209(June 1974).

The ignition conditions and static characteristics of a discharge maintained by an electron beam (current 0 to 100 mA, energy 500 to 3000 V) in a longitudinal magnetic field (B = 0 to 800 G) and in a radial electric field (E_r = 0 to 100 V/cm) have been studied. The ignition curves of this discharge are similar to those of a magnetron discharge, and it is called a "beam-magnetron discharge." The critical electron-beam current, the working pressure in the ionization chamber ($p \approx 10^{-4}$ torr), and the magnetic and electric fields required for ignition have been determined. It may be possible to use this discharge in plasma injectors, ion sources, and other devices in which the working medium is a chemically active gas or a solid. (auth)

29257 COAXIAL PLASMA INJECTOR WITH PROGRAMMED INJECTION. Burtsev, V. A.; Litunovskii, V. N.; Nadgornaya, M. P. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 736-740(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1168-1175(June 1974).

An experimental study was conducted of the physical processes in the interelectrode region of a coaxial injector with closely spaced electrodes, a short ringing time, programmed injection, and preliminary ionization of the gas by an induction electric field. Phenomena which precede the current front and which were observed in previous work are also observed here. In addition, plasma-conductivity and emission fronts are observed; these move with velocities governed by the pressure gradient in the leading part of the initial gas distribution. The present results are compared with earlier results. (auth)

29258 NON L. T. E. POPULATIONS AND RELATED QUANTITIES FOR H-H^--e PLASMAS AS A FUNCTION OF THE CUT-OFF LEVEL. Cacciatore, M.; Capitelli, M. (Bari Univ. (Italy). Dipartamento di Chimica). Z. Naturforsch., a; 29: No. 10, 1507-1509(Oct 1974).

The influence of the choice of the cut-off level n^* on the evaluation of the coefficients of quasistationary plasmas has been studied. The numerical results show that the coefficient $r_1(i)$ which represents the contribution of the population density of the ith excited level by direct excitation from the ground level, is strongly affected by the choice of n^*. A minor influence is observed (1) on the coefficient $r_0(i)$ which represents the contribution to the population density of the ith level from the continuum of free electrons and (2) on the collisional-radiative recombination (α) and ionization (S) coefficients. (auth)

29259 PRELIMINARY INVESTIGATIONS OF A NON-CYLINDRICAL Z-PINCH SUPPLIED FROM A 25 kJ CURRENT GENERATOR. Nowikowski, J. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 19: No. 12, 1081-1090(1974).

A brief description is given of a NZP-25 experimental device designed for noncylindrical Z-pinch investigations in the Mather-type electrode system, as well as the results of measurements of some of the basic physical values connected with the above phenomena as achieved in the course of the preliminary investigations. Discharge currents at a deuterium pressure of 1 torr and a condenser bank charging voltage of 36 kV achieved a maximum of 290 to 300 kA with a rise-time of 2.5 to 2.6 μsec. The occurrence of a hot plasma cumulation zone (a noncylindrical Z-pinch) in the vicinity of the center electrodes face was established in which the average electron energy was estimated to be 1.5 to 3 keV. The neutron yield was measured as a function of the deuterium pressure within the range of 0.5 to 2 torr, and as a function of the condenser bank charging voltage within the range of 30 to 36 kV. The maximum neutron yield at the 1 torr deuterium pressure and at a charging voltage of 36 kV achieved a value of 2×10^9. (auth)

29260 NOTE ON PASCHEN LAW AND THE SIMILARITY THEOREM AT THE MINIMUM BREAKDOWN VOLTAGE. Raju, G. R. G.; Hackam, R. (Univ., Sheffield, Eng.). IEEE Trans. Plasma Sci.; PS-2: No. 2, 63-65(Jun 1974).

An explanation for the higher sparking potential values of the Paschen minimum measured in concentric coaxial fields compared to uniform fields is given. The failure of the similarity theorem in some gases when applied to the sparking potentials in uniform fields at the Paschen minimum is attributed to non-equilibrium ionization effects. (auth)

29261 INSTABILITIES IN SELF-FOCUSED ELECTRON BEAMS. Gibson, R. A.; Bennett, W. H. (North Carolina State Univ., Raleigh). IEEE Trans. Plasma Sci.; PS-2: No. 3, 174-181(Sep 1974).

The appearance of large amplitude oscillations and attenuation of beam current has been observed in high perveance electrically self-focused beams. These phenomena are shown to be due to instabilities produced by the interaction of the beam with its self-generated plasma. The critical current which must be exceeded for the instabilities to appear and the frequencies of the oscillations have been related to beam and background parameters and the dimensions of the experimental system. (auth)

Plasma Kinetics (Experimental)

29262 (TRITA-EPP-74-03) EXPERIMENT ON THE INTERACTION BETWEEN A PLASMA AND A NEUTRAL GAS. II. Danielsson, L. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Feb 1974. 48p. Dep. NTIS (US Sales Only) $5.50.

A report on an experiment where an interaction between a plasma and a neutral gas in relative motion is demonstrated is presented. If the relative velocity is high enough the interaction leads to heating of the electrons, partial ionization of the gas and braking of the motion. The limiting velocity is found to be very close to Alfven's critical velocity. Measurements on the polarization of emitted spectral lines have yielded information on the velocity distribution of the electrons. New evidence is also presented on the electron heating and for the necessity of a magnetic field for the interaction to take place. The previously observed minimum gas density is also discussed. (auth)

29263 X-RAY BREMSSTRAHLUNG MEASUREMENTS OF AN INTENSE RELATIVISTIC ELECTRON BEAM PROPAGATING IN A PLASMA. Logan, B. G.; Dove, W. F.; Gerber, K. A.; Goldenbaum, G. C. (Naval Research Lab., Washington, DC). IEEE Trans. Plasma Sci.; PS-2: No. 3, 182-186(Sep 1974).

Information on the peak electron energy, angular spread, and current density of a relativistic electron beam propagating in a plasma column is obtained from measurements of two-absorber transmission ratios, anistropy, and intensity, respectively, of x-ray bremsstrahlung from thin target foils in the plasma. Measurements indicate a 10% loss in peak electron energy and a factor of two loss in peak beam intensity over the distance of the plasma column, and show a large angular spread in the beam. (auth)

Plasma Kinetics (Theoretical)

29264 (EUR-CEA-FC-754) IMPORTANCE OF TRAPPING IN STRONG PLASMA TURBULENCE. Rolland, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Oct 1974. 14p. Dep. NTIS (U. S. Sales Only) $4.00.

Sturrock's theory of stochastic acceleration and Dupree's theory of strong plasma turbulence are derived in a very simple way, showing that trapping cannot be correctly taken into account by this kind of theory. A comparison of Sturrock and Dupree's dif-

fusion coefficients D shows that Dupree's theory fails exactly in that domain where it significantly differs from Sturrock's theory and where it gives the highest values of D. The need for a theory taking trapped orbits into account appears clearly. (auth)

29265 (TRITA-EPP-74-09) TEST OF A PROPOSED LOW PRESSURE DISCHARGE THEORY. Torven, S. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Elektronfysik). Mar 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

It has been proposed that limitation of the steady electric current in a low pressure arc plasma is associated with the maximum electron number density predicted by applying the Tonks–Langmuir integral equation for the radial electric field to a strongly ionized plasma column. This equation is investigated for large ionization degrees not covered by earlier numerical investigation. Except for very low gas pressures, theoretically predicted limiting values are found to disagree with recently published experimental investigations on formation of current limiting space charge sheaths in a mercury plasma, and no explanation of current limitation seems to exist within the frame of the Tonks–Langmuir theory. The physical basis of this theory is discussed, and it is concluded that more general models for the ion motion are necessary to describe a strongly ionized plasma. (auth)

29266 (UCRL-5161(Rev. 1)) HYBRID-II, A TWO-DIMENSIONAL MULTISPECIES FOKKER-PLANCK COMPUTER CODE. Mirin, A. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1975. Contract W-7405-Eng-48. 72p. Dep. NTIS $5.45.

The computer program Hybrid-II solves the time-dependent two-dimensional Fokker-Planck equation for an arbitrary number of ion species plus electrons. The two velocity dimensions are velocity magnitude and pitch angle, and it is assumed that the electron distribution is a function of velocity magnitude only. The program may be applied to problems in the areas of both mirror confinement and toroidal confinement. In the former case, a self-consistent ambipolar potential is computed to assure charge neutrality. The ion distribution functions are integrated in time using either a split semi-implicit algorithm or an alternating-direction-implicit (A. D. I.) difference scheme. The electron distribution function is advanced using either a semi-implicit or fully-implicit difference algorithm. In addition, since the electrons are usually on a faster time scale than the ions, a multiple number of smaller electron time steps per large ion time step may be employed to increase the accuracy of the electron integration. The ion velocity and angular finite-difference meshes usually consist of 45 and 14 points, respectively. The electron velocity mesh, which is an extension of the ion velocity mesh, usually consists of 201 points. The field length for a four species calculation on the above mesh is approximately 75,000 (decimal), and the running time is approximately 80 time steps per minute. No tapes or disc files are necessary for code input or for the operation of the code. Both plots and printed data (including microfiche) comprise the output. (auth)

29267 LINEAR THEORY OF A COLD RELATIVISTIC BEAM PROPAGATING ALONG AN EXTERNAL MAGNETIC FIELD. Godfrey, B.B.; Shanahan, W.R.; Thode, L.E. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 18: No. 3, 346-355 (Mar 1975).

The linear theory of a cold relativistic electron beam propagating parallel to an external magnetic field and through a cold, homogeneous plasma is investigated. The electromagnetic dispersion relation is solved numerically and compared with analytical predictions based on the electrostatic approximation. It is found that electromagnetic effects are important for determining the entire unstable spectrum. However, except for the strong magnetic field regime, the maximum growth rates and corresponding frequencies are in agreement with those predicted by the electrostatic approximation. In the strong magnetic field regime the two–stream spectrum is found to be much narrower in angle than predicted by the electrostatic approximation. In the moderate and strong magnetic field regime the growth rate of waves propagating at large angles with respect to the beam are independent of beam energy. (auth)

29268 PARTIAL TRAPPING OF A BEAM IN A COLD COLLISIONAL PLASMA. Winske, D.; Jackson, E.A. (Department of Physics and Coordinated Science Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Fluids 18: No. 3, 389-390 (Mar 1975).

It is shown that the nonlinear trapping of an electron beam in a cold plasma with electron–ion collisions can result in only a partial trapping of the beam. The electrons separate into two groups, one near their original velocity and the other at a lower, secularly decreasing wave velocity. (auth)

29269 USE OF QUASI-NORMALITY ASSUMPTIONS IN THE THEORY OF THE TWO-DIMENSIONAL GUIDING-CENTRE PLASMA. Cook, I. (United Kingdon Atomic Energy Authority, Abingdon, Eng.). J. Plasma Phys.; 12: 501-507(Dec 1974).

It is argued that the use of quasi-normality or "random phase" approximations in the kinetic theory of the two-dimensional guiding-center plasma gives rise to unphysical and inconsistent results. (auth)

29270 VALIDITY OF THE WEAK-COUPLING APPROXIMATION IN STRONG PLASMA TURBULENCE. Rolland, P. (CEN, Grenoble, France). J. Plamsa Phys.; 12: 455-465(Dec 1974).

The weak-coupling approximation takes stochastic perturbations of orbits into account, but neglects a part of mode coupling. This approximation, which is non-trivial, is discussed here. Its domain of validity appears to be $\tau_E \ll \tau_t$, provided the turbulence is strong enough so that $\gamma_{NL}-\gamma_L \sim \gamma_L$. If $\gamma_{NL}-\gamma_L \ll \gamma_L$ a stronger condition is required. It is shown that the growth rate γ_{NL} can be calculated either from the nonlinear dispersion equation $\epsilon_{NL} = 0$, or from the energy equation, provided the propagator conserves particles. Dupree's propagator $\bar{U}$ does not do this; but it gives a correct approximation of γ_{NL}, provided $\Delta v \ll v_{th}$. (auth)

29271 ANODE SPOT INSTABILITY. I. The Homogeneous Short Gap Instability. Ecker, G. (Ruhr-Univ., Bochum, Ger.). IEEE Trans. Plasma Sci.; PS-2: No. 3, 130-146(Sep 1974).

If the current in a "vacuum arc" surpasses a certain critical value a conspicuous and destructive phenomenon occurs at the anode, the anode constriction instability or anode spot formation. A quantitative analysis is given of this phenomenon within the limits of a model which can be characterized by lateral homogeneity, collision dominance and small electrode separation. Matching the various model regions results in a differential equation for the anodic spot area which exhibits an anode constriction instability of the "explosive type." A marginal instability criterion is derived and evaluated for various materials. This yields extensive information about the dependence of the constriction instability on the parameters of the experimental set up. The findings are compared with the experimental results and show satisfactory agreement within the limitations of experiments and theory. (auth)

29272 TWO DIMENSIONAL GENERALIZATION OF RAIZER'S ANALYSIS FOR THE SUBSONIC PROPAGATION OF LASER SPARKS. Batteh, J. H.; Keefer, D. R. (Univ. of Florida, Gainesville). IEEE Trans. Plasma Sci.; PS-2: No. 3, 122-129(Sep 1974).

An extension to two dimensions of Raizer's analysis for the steady state, subsonic propagation of laser sparks is presented. A solution in closed form is obtained for a simplified, two dimensional energy equation, yielding both axial and radial temperature profiles as well as the relationship between incident laser intensity, laser radius and propagation velocity. The propagation mechanism is assumed to be thermal conduction and radiation losses are included in a phenomenological manner. The solution is obtained for a laser spark propagating in a channel and therefore can be used to investigate the effect of a boundary on spark propagation. The solution also allows calculation of the radial heat conduction parameter A introduced by Raizer for use in one-dimensional approximations. Sample calculations are presented for air sparks of 0.15 and 0.50 cm radius. (auth)

Plasma Production

29273 (UCRL-51706) IRRADIATION OF SPHERICAL TARGETS WITH MULTIPLE BEAMS AND HEMI-REFLECTORS. Phipps, C. R. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1974. Contract W-7405-Eng-48. 25p. Dep. NTIS $4.00.

Approaches to the design of spherical irradiation facilities for laser fusion experiments are discussed. The purpose of such a facility is to focus multiple laser beams onto a spherical target, giving nearly total coverage and uniform intensity. It is assumed that each beam has a well defined phase and an intensity distribution which is cylindrically symmetric, but with an unspecified radial variation. The optical designs which are discussed have in common the use of conic section reflectors to illuminate the target. For each system discussed, mapping functions are derived which relate the requirement for uniform irradiation of a sphere to a unique intensity distribution at the system entrance pupil. Means are described for combining the multiple laser beams to approximate the unique distribution of intensity required by the spherical irradiation system. Also discussed are the intensity mapping properties of beam expanding optics, and the impact of wrap-around optical systems on target diagnostics emplacement. (auth)

29274 (UCRL-76241) FLUID DYNAMICS AND STABILITY OF COMPRESSIBLE IMPLODING SHELLS. Kidder, R. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1974. 23p. (CONF-741234-1). Dep. NTIS $4.25.

From conference on the physics of plasma induced by lasers and electron beams; Arad, Israel (29 Dec 1974).

The mechanical power P_M required to achieve a given ρR-product by the implosion of thin shells is calculated. It was assumed that the shell is gently accelerated from rest by an external pressure that increases initially with time to produce a homogeneous isentropic compression, and then makes a smooth transition to a (slower) exponential rate of increase. This specification provides a convenient one-parameter family of pressure-time relations, the exponential rate of increase having been found empirically to be near-optimum in a series of detailed computer calculations. Having determined the power required to implode thin shells as compared with solid pellets, the Rayleigh-Taylor instability was treated for both solid pellets and thin shells undergoing homogeneous isentropic compression. An important feature of this treatment is that it takes into account the compressibility of the fluid medium, a property that increases the growth-rate of long-wavelength perturbations in the case of thin shells. (MOW)

29275 (UCRL-Trans-10820) INTERACTION OF THE RADIATION OF A HIGH-POWER LASER WITH A LiD TARGET. Dubovoi, L. V.; Dyatlov, V. D.; Kryzhanovskii, V. I.; Mak, A. A.; Medvedev, R. N.; Popytaev, A. N.; Serebryakov, V. A.; Sizov, V. N.; Starikov, A. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. Translated from NIIEFA Preprint T-0185. 13p. Dep. NTIS $4.00.

The parameters of a plasma generated by a high-power Nd laser in irradiation of an LiD target were investigated. The neutron yield, which reaches 6×10^5 neutrons/4π, was measured together with the electron temperature, which had a value of 1 to 2 keV. The relationship between the reflection factor and the intensity of incident radiation was found. It cannot be accounted for by the classical interaction mechanism. (auth)

29276 BACKGROUND GAS PRESSURE DEPENDENCE AND SPATIAL VARIATION OF SPONTANEOUSLY GENERATED MAGNETIC FIELDS IN LASER–PRODUCED PLASMAS. Case, R.S. Jr. (Air Force Weapons Laboratory, Albuquerque, New Mexico 87117); Schwirzke, F. J. Appl. Phys. 46: No. 4, 1493-1498 (Apr 1975).

A spontaneous aximuthal magnetic field generated by electron currents which flow during the interval that a high–brightness 4–nsec full width at half–maximum intensity ruby laser was incident on a metallic target has been detected, its spatial characteristics evaluated, and its dependency upon background gas pressure investigated both experimentally and theoretically. The propagation velocity of the early component of this magnetic field is greater than 10^8 cm/sec, more than an order of magnitude larger than the plasma convective velocity, and indicates that the electron currents responsible for this fast field must flow through the background photoionized gas. The early component is first detected at a pressure of 5×10^{-6} Torr, and for a fixed spatial location, reaches a peak intensity at a pressure of 2×10^{-3} Torr. Its intensity is typically on the order of 1–10 G, a factor 10–100 times smaller than the spontaneously generated magnetic fields which are driven by pressure gradient effects in the expanding laser plasma. The pressure dependence of the pressure gradient magnetic field has also been evaluated and compared with previous experimental results, obtained at laser pulse lengths of greater than 20 nsec. (auth)

29277 TARGETS FOR ELECTRON–BEAM FUSION. Clauser, M.J. (Plasma Theory Division, Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. Lett. 34: No. 10, 570-574 (10 Mar 1975).

I have performed computer simulations of high–density, spherical shells containing DT gas, irradiated by pulsed electron beams. For these targets, (1) the optimal shells are thick enough that few electrons reach their inner surface, (2) the low–level bremsstrahlung which penetrates the shell significantly affects the target performance, (3) breakeven requires about 10^{15} W deposited for 5 nsec. This represents a considerable improvement over the behavior of bare DT spheres; further improvements may reduce the power to 10^{14} W. (auth)

29278 OBSERVATION OF INFRARED REFRACTION IN A LASER-PRODUCED PLASMA. Keilmann, F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics); Chase, C. E. (Massachusetts Inst. of Tech., Cambridge (USA). National Magnet Lab.). Phys. Lett., A; 50: No. 5, 374-376(30 Dec 1974).

In this letter, infrared refraction is shown to yield a consistent estimate of the electron density in a laser-produced plasma. (auth)

29279 CALCULATION OF THE REDUCED PENETRATION DEPTH OF RELATIVISTIC ELECTRONS IN PLASMAS FOR NUCLEAR FUSION. Bagge, E. R. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik); Hora, H. (Australian National Univ., Canberra. Research School of Physical Sciences). Atomkernenergie; 24: No. 2, 143-144(1974). (In German).

The Bethe-Bloch-formula for the absorption depth of electrons in neutral solid targets has been corrected for plasmatized targets by Bagge. This correction explains completely the measured 40 times less absorption depth for 2 MeV electrons in CD_2-plasmas compared to solids. An electron beam controlled compression scheme for nuclear fusion plasmas is proposed. (auth)

29280 TARGET COMPRESSION WITH ONE BEAM. McCall, G. H.; Morse, R. L. (Los Alamos Scientific Lab., NM). Laser Focus; 40-44(Dec 1974).

Pellet structures for laser compression experiments for controlled fusion are discussed. The use of a single laser beam to compress the target is described considering a "ball and disk" target geometry. X-ray pinhole photography was used to show a picture of the implosion process. (MOW)

29281 LASER-DRIVEN COMPRESSION OF GLASS MICROSPHERES. Campbell, P. M.; Charatis, G.; Montry, G. R. (KMS Fusion, Inc., Ann Arbor, MI). Phys. Rev. Lett.; 34: No. 2, 74-77 (13 Jan 1975).

Volume compressions on the order of 10^2 were observed in glass microspheres heated by pulses from a Nd glass laser. The degree of compression is inferred from computer analysis of time-integrated x-ray photographs of the target plasma. (auth)

Plasma Stability

29282 (EUR-CEA-FC-747) COMPUTATION OF PERTURBED FIELDS AND PRESSURE BALANCE CONDITIONS FOR THE NON-LINEAR KINK COUPLING PROBLEM. Dagazian, R. Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Aug 1974. 9p. Dep. NTIS (U. S. Sales Only) $4.00.

A detailed outline is given of the computer work which leads to the calculation of the perturbed fields and of pressure balance conditions relevant to a stability study of cylindrical magnetic configurations. This calculation is carried out to the third order in the amplitude of the two linearly marginal modes whose beating is analyzed: the m = 1, n = 1 internal mode and the m = 2, n = 1 external kink. Besides its numerical aspect, this work has involved the extensive use of FORMAC, a symbolic manipulation compiler. (auth)

29283 (LA-5853-MS) TOROIDAL MODE STRUCTURE IN THE SCYLLAC FULL TORUS. Jahoda, F. C.; Kristal, R.; Quinn, W. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

A 360° multiple-slit framing camera (11 viewing slits) has shown that the Scyllac toroidal mode structure is consistent in a statistical sense with the m = 1 instability predictions of MHD sharp-boundary theory. The first few modes of finite wavelength around the torus have growth rates comparable to the k = 0 mode, and the developed plasma mode structure approaches cut-off at the theoretical value given by magnetic field bending effects. The data indicate that the m = 1 instability rather than loss of equilibrium terminates the plasma confinement. (auth)

29284 DEFORMATION OF ELECTROMAGNETIC PULSE UPON DEVELOPMENT OF PARAMETRIC INSTABILITY IN A PLASMA LAYER. Zhislin, G.M.; Litvak, A.G.; Mityakov, N.A.; Petrukhina, V.I.; Rapoport, V.O.; Trakhtengerts, V.Y. (Radiophysics Research Institute). JETP Lett. 20: No. 9, 282-284 (5 Nov 1974).

We consider numerically and analytically a modified decay instability in a bounded plasma layer. We show that deep amplitude modulation of the incident was taken place at the exit from the plasma layer, as well as a lengthening of the electromagnetic pulse due to the "emission" of the turbulence accumulated in the plasma after the pump wave is turned off. (auth)

29285 EFFECT OF COLLISIONS ON AN IMPURITY PLASMA MODE. Wong, S.K. (General Atomic Company, San Diego, California 92138). Phys. Fluids 18: No. 3, 391-392 (Mar 1975).

Calculations of the effect of collisions on an impurity plasma mode with a Krook model shows that the instability criterion is unaffected by collisionality up to very high collision frequencies. (auth)

29286 CONVECTIVE AND ABSOLUTE INSTABILITIES IN BEAM–PLASMA SYSTEMS. Manickam, J.; Carr, W.; Rosen, B.; Seidl, M. (Department of Physics, Stevens Institute of Technology, Hoboken, New Jersey 07030). Phys. Fluids 18: No. 3, 369-379 (Mar 1975).

The linear theory of a mono–energetic electron beam interacting with a cylindrical, homogeneous, Maxwellian magnetoplasma is investigated numerically. Using standard criteria the instability of the upper branch ($\omega > \omega_{ci}$; $\omega \sim k_z V$) is shown to be either convective or absolute depending on the specific beam and plasma parameters. In the weak beam limit, $n_b \ll n_p$, a cubic dispersion equation is derived to describe the same system. The cubic equation is analyzed to show that the instability is convective when the group velocity of the plasma wave is positive. The instability is absolute when the group velocity of the

plasma wave is negative and when the beam density exceeds a threshold density. (auth)

29287 EFFECT OF IMPURITIES ON TRAPPED PARTICLE MODES. Bhadra, D.K. (General Atomic Company, San Diego, California 92138). Phys. Fluids 18: No. 3, 380-383 (Mar 1975).

The nature of the trapped particle modes in a toroidal geometry has been investigated in the presence of impurity ions using a model magnetic field configuration. The various trapped ion and electron modes have been studied and the condition for their stabilization derived. Existence of some new modes with impurities in the "banana" regime has been shown. (auth)

29288 EVOLUTION OF THE ION–ACOUSTIC INSTABILITY IN A DIRECT–CURRENT DISCHARGE PLASMA. Yamada, M.; Raether, M. (Department of Physics and Coordinated Science Laboratory, University of Illinois at Urbana–Champaign, Urbana, Illinois 61801). Phys. Fluids 18: No. 3, 361-368 (Mar 1975).

The nonlinear development of the ion–acoustic instability in a weakly ionized helium plasma has been investigated. Measurements of the magnitude and frequency dependence of the energy spectrum are consistent with the idea that the resultant turbulent state is controlled by competition between trapping of electrons by the waves and untrapping by either electron–neutral or Coulomb collisions. The effect of a dc electric field on the instability is discussed and additional data on the linear spatial growth rate and the unstable frequency range are presented. (auth)

29289 DESTABILIZING EFFECTS FROM A FAST–ISOTROPIC ION COMPONENT. Mai, L.P.; Horton, W. Jr. (Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 18: No. 3, 356-360 (Mar 1975).

The destabilizing effects of a fast, isotropic ion component are calculated for the principal electrostatic plasma modes. The change to $\gamma_k = \mathrm{Im}\,(\omega_k)$ is given for a class of peaked energy distributions ranging from mono–energetic to near Maxwellian. (auth)

29290 APERIODIC INSTABILITY IN A PLASMA GAP WITH EXTERNAL FEEDBACK. Igritskii, A. N. (Engineering-Physics Inst., Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 719-721(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1137-1142(June 1974).

A complete numerical solution is found for the dispersion relation for nonlinear aperiodic electrostatic waves in a homogeneous plasma gap. The nonlinear instability of the stable solutions with an adiabatic change in the boundary conditions is discussed. The nonlinear growth rate is much larger than the linear growth rate. The sensitivity of the growth rate to C and R elements in the external feedback circuit is analyzed. (auth)

29291 NONLINEAR FEEDBACK CONTROL SYSTEM FOR PLASMA CONFINEMENT. Millner, A. R. (Massachusetts Inst. of Tech., Lexington). IEEE Trans. Plasma Sci.; PS-2: No. 3, 147-151(Sep 1974).

An analytical study of feedback stabilization of a continuum is done in the context of plasma confinement in a TOKAMAK device. Linear and nonlinear "bang-bang" feedback from discrete stations is investigated to find acceptable sensor and enforcer element geometries, compare their effectiveness, and predict the important parameters in their realization. The primary method used is an extension of the energy method. (auth)

29292 BACKSCATTERING AND ABSORPTIVE PARAMETRIC INSTABILITIES INVOLVING THE LOWER HYBRID MODE IN A MAGNETIZED PLASMA. Lee, K. F. (Chinese Univ. of Hong Kong, Shatin). IEEE Trans. Plasma Sci.; PS-2: No. 3, 187-192 (Sep 1974).

The theories of two decay-type parametric instabilities involving the lower hybrid mode in a magnetized plasma are presented. In the first of these, a pump wave of ordinary polarization causes the growth of a backward propagating transverse wave and a longitudinal lower hybrid wave, all with wave vectors perpendicular to the external magnetic field. The second instability concerns the parametric excitation of the upper hybrid and the lower hybrid modes. (auth)

Thermonuclear Engineering and Equipment

29293 (BNL-19008) INITIATION OF THERMONUCLEAR DETONATIONS. Maschke, A. W. (Brookhaven National Lab., Upton, N. Y. (USA)). 5 Jun 1974. 14p. Dep. NTIS $4.00.

Some simple relations describing a thermonuclear detonation in a deuterium-tritium mixture are derived. An ignition system is proposed which consists of a storage ring, (or set of them) in which a bunched beam is stacked up to the transverse space charge limit. The particles are then extracted and focused to an appropriate spot. It is this sudden heating which then initiates the thermonuclear shock wave in the fuel. The practical problems of storing and focusing of the beam and containment of the detonation are not treated in this note, but will be dealt with in a later paper. (auth)

29294 (BNWL-1835) STATUS REPORT: MIRROR HYBRID REACTOR STUDIES. Stokes, E.; Reppond, E. (eds.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1974. Contract AT(45-1)-1830. 87p. Dep. NTIS $7.60.

A scope design effort for a mirror hybrid reactor was undertaken to estimate the performance characteristics of this type of fission-fusion system. The basic blanket is a composite convertor/fissile lattice configuration which is based upon previous work at PNL. The fissile lattice materials and arrangement were selected as representative of gas cooled thermal reactor technology. The scope design included analysis of plasma physics characteristics, blanket neutronic and thermal hydraulic characteristics, magnet design considerations, and injector design. A basic aim of the study was to provide bases for understanding the shortcomings and advantages of hybrids. (auth)

29295 (BNWL-1890) ANNUAL REPORT FOR 1974 ON CONTROLLED THERMONUCLEAR REACTOR TECHNOLOGY. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-1830. 83p. Dep. NTIS $7.60.

The PNL has been studying fusion technology in areas such as economics, fusion-fission hybrid concepts, materials, neutronics, environment and safety. Areas of study with other laboratories in 1974 include the design of fusion reactors, the understanding of material properties, and the environmental effects of fusion reactor power plants. In fusion reactor design, PNL staff contributed to Tokamak reactor design efforts at the University of Wisconsin in the areas of economic assessment, the compatibility of helium and lithium coolants with structural materials, and the technology of tritium handling and containment. A cooperative study of the design of a fusion-fission hybrid reactor and based upon the mirror concept of plasma confinement was carried out with the staff of Lawrence Livermore Laboratory. In addition, PNL staff contributed to studies carried out at Lawrence Livermore Laboratory on design of a Fusion Engineering Research Facility (FERF). In depth discussions have been held with scientists from several laboratories on the environmental effects of fusion power plants. These discussions included fusion reactor designs, magnetic technology, biological effects of magnetism and tritium technology. Progress during 1974 are summarized in areas of systems design and analyses, materials research, and environmental effects. Since controlled thermonuclear reactor designs are only conceptual at this time, their characteristics are very tentative and the economics of various designs can only be studied in a very preliminary way. An envelope of reactor characteristics is being developed and analyzed to determine CTR operating characteristics necessary to achieve a satisfactory return on research investment. One concept that has some unique benefits is the fusion-fission hybrid in which a fission blanket is placed around a fusion core. Thus, studies are included to identify economic regimes for the hybrid concept. Improvements in analytical capability are being sought to improve the validity of technical bases for CTR design and the transfer of technology to industrial capability. Present studies directed toward these goals involve the acquisition of improved nuclear data and data files, and the transfer of technology to industrial capability. These studies are being pursued as part of the hybrid reactor design program. Structural and coolant materials applicable to CTR concepts are being studied to determine damage effects that could affect fabrication and performance of CTR components. For example, damage mechanisms which might affect the first wall, or the use of graphite in the blanket and/or shield regions, are being investigated. In addition, studies are being made on material compatibility with helium coolant and the effects of helium on the mechanical properties of vanadium and niobium. Methods for producing certain insulator coatings and barrier surfaces are in the experimental stage and tests of the resulting coatings are being planned. Environmental assessments are being made on the basis of information available, to help identify impacts that might indicate modification of research and development studies. Technical analysis has begun where information is available. A review of available information is in progress to make recommendations for additional data where needed to help assure the protection of the public and the environment. (auth)

29296 (CONF-750303-26) ADVANCED FUELS FOR NUCLEAR FUSION REACTORS. McNally, J. R. Jr. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 5p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Should magnetic confinement of hot plasma prove satisfactory at high beta ($\Sigma 8\pi nkT/B^2 > 0.2$), nuclear fusion fuels other than DT will be important in future fusion reactors. The prospect of the advanced fusion fuels DD and ^{6}LiD in such fusion reactors appears very promising provided the system is large, well reflected and has a sufficiently high density and temperature (high beta). Steady state burning of DD can ensue in a 60 kG field, 5m radius reactor for $\beta \gtrsim 0.1$ and wall reflectivity $R_\mu = 0.9$. The first generation thermonuclear reactions between D and D or ^{6}Li produce the very active, energy-rich fuels t and ^{3}He which exhibit a high burnup probability in very hot plasmas. Steady state burning of ^{6}LiD has also been demonstrated theoretically for low concentrations of ^{6}Li; however, important features of the ^{6}LiD system still need to be incorporated in the calculation. In particular, there is a need for new and improved nuclear cross section data on over 80 reaction possibilities. (auth)

29297 (CONF-750335-7) ION BEAM COMPRESSOR FOR PELLET FUSION. Martin, R. L. (Argonne National Lab., Ill. (USA)). 1975. 3p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Intense ion beams of short duration can be created by charge exchange injection into a number of small, high field storage rings. If the beams are extracted and focussed from many directions simultaneously onto a DT pellet, a beam of protons or α particles of 15,000 to 30,000 A for a duration of 1 to 2 ns can result. Such beams have possibilities for compressing and heating to fusion temperatures submillimeter pellets of a DT mixture. The potential of this method is discussed. (auth)

29298 (COO-2218-25) ENERGY BALANCES FOR FUSION–FISSION HYBRIDS. Miley, G. H. (Illinois Univ., Urbana (USA)). 27 Dec 1974. 23p. (CONF-741220-2). Dep. NTIS $4.25.

From fusion-fission energy systems meeting; Washington, District of Columbia, USA (3 Dec 1974).

Graphs are presented to evaluate the effect of blanket energy multiplication on fusion plasma requirements and overall plant efficiency. An example is given where a fusion plasma characterized with a Q_p-value corresponding to about $\frac{1}{3}$th of the Lawson breakeven value and about $\frac{1}{7}$th of the classical confinement value is able to drive a well-subcritical uranium blanket and still provide reasonable overall plant efficiencies for electrical production. (auth)

29299 (ERDA-5) PROCEDURES GOVERNING THE INITIATION AND FABRICATION OF MAJOR PROJECTS AND MAJOR DEVICES WITHIN THE CONTROLLED THERMONUCLEAR RESEARCH PROGRAM. (USERDA Division of Controlled Thermonuclear Research, Washington, D. C.). Feb 1975. 17p. Dep. NTIS $4.00.

A detailed description and a flow-chart of the Procedures Governing the Initiation and Fabrication of Major Projects and Major Devices within the Controlled Thermonuclear Research Program are outlined. Close cooperation of the laboratories with DCTR and the field offices in these procedures should facilitate planning of research and achievement of the goals of controlled fusion research. (MOW)

29300 (IPP-4/119) THE MHD PRESSURE LOSSES AS A POSSIBLE CRITERION FOR THE SELECTION OF STRUCTURE MATERIALS FOR FUSION REACTOR BLANKETS. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Aug 1974. 14p. INIS.

From reactor meeting; Berlin, F.R. Germany (2 Apr 1974).

In the present stage of fusion reactor development no decision can be made concerning the optimum structure material to be used in the blanket region. This paper deals with a comparison of four candidate materials in view of the effects caused by MHD pressure losses. All materials considered–stainless steel, vanadium, niobium, and molybdenum–have chances if the absolute pressure drop is the quantity of interest. Only vanadium and molybdenum remain in consideration if the amount of material is essential. (AH)

29301 (IPP-4/122) SYSTEMS: A COMPUTER PROGRAM FOR EVALUATING THE MAIN PHYSICAL AND TECHNOLOGICAL PARAMETERS OF FUSION REACTORS. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Sep 1974. 55p. Dep. NTIS (U. S. Sales Only) $5.75.

SYSTEMS is a program system for evaluating the main physical and technological parameters of fusion reactors. The current version should be regarded as a preliminary one. Further refinements and extensions will be provided in the future. The first part of this report describes the calculation procedure and lists all formulas used. The second part is devoted to explaining the program structure and includes a series of remarks on the input and output operations. A reference list of all output quantities as well as an input and an output sample are presented in the Appendix. (auth)

29302 (JPRS-62678) CONTROLLED THERMONUCLEAR FUSION IN INSTALLATIONS WITH DENSE PLASMA. Budker, G. I. Translated from Priroda; No. 5, 14-21(1974). 16p. NTIS $3.00.

A description of controlled thermonuclear fusion in dense plasmas and the construction of a thermonuclear reactor is presented. (GRA)

29303 (LA-5849-MS) DEUTERIUM FLOW LOOP FOR A SUPERSONIC GAS-TARGET INTENSE NEUTRON SOURCE. Cort, G. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 17p. Dep. NTIS $4.00.

One of the milestones to be passed in the National Controlled Thermonuclear Research (CTR) program is a thorough knowledge of the effects of high-level neutron irradiation on materials. The early needs for a high-fluence 14-MeV Intense Neutron Source (INS) to carry out such relevant studies can best be met by the supersonic gas-target approach. The INS will consist basically of two intersecting beams, one of 1.5 A of 270-keV tritium ions and the other a supersonic jet of deuterium molecules. The collisional intersection of these two beams will be the source of 14-MeV neutrons from the resultant D-T reaction. Parametric calculations of inviscid one-dimensional gas dynamics and heat transfer in the deuterium flow loop (consisting of inlet plenum, target area, supersonic and subsonic diffuser sections, heat exchanger, and compressor) are described in this report. The objective was to size components and estimate operating conditions for the loop. Three parameters are relatively fixed for the INS design being considered: (1) the kinetic energy of the tritium ion beam is 300 kW; (2) the density of the deuterium gas in the target area (where the beams intersect) should be 2×10^{19} molecules/cm^3 for adequate stopping power; and (3) the diameter of the target area should be small (<1.5 cm) to maximize the neutron flux. With these limitations, and to satisfy the nonchoking condition at the exit of the target, the entering deuterium must be at high pressures (44 MPa) and stagnation temperatures (858°K) with a Mach number of about 6. The deuterium mass flow is 0.08 kg/s and the stagnation temperature leaving the target area is 1375°K. The cycle compression ratio is about 40 and the ideal compressor work is 430 kW. Parametric curves are given which include the sizes of components and the gas dynamic conditions throughout the deuterium loop. The conceptual design appears to be feasible, but experimental studies are recommended to investigate effects of boundary layers in conjunction with the supersonic flow and heat addition. (auth)

29304 (LGI/R/PLAD-73.9/E) INVESTIGATION ON A PLASMA FOCUS. Samuelli, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Gas Ionizzati). Dec 1973. 228p. Dep. NTIS (U. S. Sales Only) $14.50.

Thesis.

A description of the mode of operation of the plasma focus and of some theoretical characteristics of the plasma is given. A model of the plasma focus, deduced from experimental results, is shown. A description and interpretation of experimental results are also given. (MOW)

29305 (ORNL-TM-4846) CENTRIPETAL FORCES IN UNIFORMLY WOUND TORUS MAGNETS WITH FINITE WALL THICKNESS. Gauster, W. F. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 11p. Dep. NTIS $4.00.

A segment of a torus is considered that corresponds to an azimuthal angle $d\psi$. This part of the winding carries the current $I_0\Delta\psi/2\pi$ over the total winding thickness $(\gamma_2 - \gamma_1)$. The torus winding is assumed to be uniform, a layer with the thickness $d\gamma$ carries the current $dI = I_0\,(\Delta\psi/2\pi)d\gamma\ (\gamma_2 - \gamma_1)$. A complete derivation for the centripetal force follows. (MOW)

29306 (ORNL-tr-2903) PROBLEMS IN THE CONSTRUCTION OF CIRCULATING SUPERCONDUCTING MAGNET SYSTEMS (TsSMS). Keilin, V. E.; Klimenko, E. Yu.; Kovalev, I. A.; Novikov, S. I.; Saprykin, Yu. E.; Samoilov, B. N.; Chernoplekov, N. A. (Oak Ridge National Lab., Tenn. (USA)). 1974. Translated by M. Gerrard of IAE-2397. 8p. Dep. NTIS $4.00.

The construction is described and the results of tests are presented for two TsSMS's – a model solenoid and the TsMS-0.25 equipment. The chief sources of heat release in TsSMS and the possibilities of their discovery and obsolescence are analyzed. (auth)

29307 (TRITA-EPP-74-12) TRENDS IN NUCLEAR FUSION RESEARCH. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Elektronfysik). 11 Apr 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

A review is given of the present state and the future possibilities of nuclear fusion research. The complex of included problems is described as well as various approaches for their solution, being based both on magnetic and non-magnetic confinement schemes. (auth)

29308 (TRITA-EPP-74-15) POWER BALANCE AND MECHANICAL STRESSES OF INTERNAL CONDUCTOR SYSTEMS. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). 5 Aug 1974. 38p. Dep. NTIS (US Sales Only) $5.00.

A number of technological problems of the coils in internal conductor systems were investigated. At technically feasible power levels and linear dimensions the Ohmic power losses can, under optimized conditions, be made much smaller than the thermonuclear reaction power, even with ordinary metal windings at temperatures of some hundred degrees centigrade. Thus, superconducting coils should not become necessary in these systems. The mechanical stresses can be kept well below the limits of tensile strength of possible coil materials. In addition, both the internal coils and their magnetically shielded supports can be made magnetically force-free in certain cases. These results are due to the fact that high beta values are, in principle, available in systems with a main poloidal field, and that only a fraction of the total magnetic field energy originates from the internal conductors. This provides an important advantage over systems with a main toroidal field where, at a given plasma pressure, the Ohmic power losses and mechanical stresses become between one and two orders larger than those of poloidal field systems. The coil supports can be made large enough to provide cooling ducts for the internal conductor system. (auth)

29309 (UCID-16724) SCALING OF FERF C-CLAMP STRUCTURE WITH COIL RADIUS AND MAGNETIC FIELD STRENGTH. Schwer, C. J.; Carlson, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Mar 1975. Contract W-7405-Eng-48. 18p. Dep. NTIS $4.00.

A C-clamp coil structure was proposed in a conceptual design study for FERF. The purpose of this paper is to generalize this structural design to permit scaling of the C-clamp structure with coil radius and magnetic field strength. (auth)

29310 (UCID-16731) PRELIMINARY REPORT ON COMPUTER CONTROL OF 2XIIB NEUTRAL BEAM SOURCES. Pollock, G. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Mar 1975. Contract W-7405-Eng-48. 21p. Dep. NTIS $4.25.

The computer control and monitoring system being built for the neutral beam sources on the 2XIIB CTR project is discussed. The problems of neutral beam source control are described in general. The present and future capabilities of the system being developed are described. The specific hardware implementation and software algorithms for each control loop are given. (auth)

29311 (UCRL-76263) ^{235}U PULSED SPHERE MEASUREMENTS AND CTR FUSION-FISSION BLANKET CALCULATIONS. Wong, C.; Anderson, J. D.; Haight, R. C.; Hansen, L. F.; Komoto, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1975. 6p. (CONF-750303-46). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The neutron emission spectra from ^{235}U spheres pulsed with 14-MeV neutrons were measured from the source energy down to 10 keV and have been compared with calculations employing ENDF/B-IV and ENDL cross sections. The low energy spectra (10 keV to 1 MeV) are best described using ENDF/B-IV cross sections while the high energy spectra (2 MeV to 15 MeV) are best described using ENDL cross sections. It is concluded that use of ENDL cross sections should yield the best estimate of tritium breeding and ENDF/B-IV that of Pu breeding in a CTR fusion-fission blanket. (auth)

29312 (UCRL-76495) DEVELOPMENT OF A RELIABLE, LOW-COST, ENERGY-STORAGE CAPACITOR FOR LASER PUMPING. Hutzler, J. R.; Gagnon, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1975. 15p. (CONF-741113-8). Dep. NTIS $4.00.

From international conference on energy storage, compression and switching; Turin, Italy (5 Nov 1974).

The 14.5-μF, 20-kV energy discharge capacitor developed in the 1950's far exceeds the present needs of laser fusion research. This unit was designed to operate under conditions of large voltage reversal and high peak currents. In glass-laser systems, voltage reversal occurs only during occasional faults, and peak currents are below 1000 A. It is relevant, therefore, to pursue lower-cost, higher energy-density capacitors, which more closely fit the requirements of laser fusion research. Several companies have designed and produced prototype units that meet the cost criteria of 5 to 6¢/J and energy density of 5 to 6 kJ/unit. (auth)

29313 (UCRL-Trans-10822) PARAMETERS OF PULSED POWER SYSTEMS FOR A THETA PINCH WITH LINER. Azizov, E. A.; Breev, V. V.; Zotova, E. A.; Ivanov, I. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Translated from a Russian paper. 22p. Dep. NTIS $4.25.

A pulsed energy system based on a magnetic implosion unit was considered; the parameters are estimated for which a demonstration thermonuclear experiment on constriction of plasma by a long cylindrical liner with open ends can be carried out. The radius of the pinched liner is found from the conservation of magnetic flux condition, with allowance for nonlinear diffusion of a megaoersted field. When the Lawson criterion is satisfied, the energy contained within the liner is independent of the field, for a copper liner, it is estimated at about 10^9 J; the maximum discharge power exceeds 10^{14} W. (auth)

29314 HIGH-ENERGY NEUTRON SPUTTERING YIELDS FROM GOLD AND NIOBIUM. Jenkins, L.H.; Noggle, T.S.; Reed, R.E.; Saltmarsh, M.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Smith, G.J. Appl. Phys. Lett. 26: No. 8, 426-428 (15 Apr 1975).

High-energy neutron sputtering yields $\lesssim 10^{-4}$ ejected particles/incident neutron have been measured for Au and Nb specimens irradiated under high-vacuum conditions using a neutron source based on the ^{9}Be(d,n) reaction. These measurements are consistent with theoretical predictions, but much lower than experimental data previously reported by one research group. (auth)

29315 ALPHA PARTICLE ENERGY ABSORPTION IN A REACTING DT SPHERE. Cooper, R.S.; Evans, F. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 18: No. 3, 332-334 (Mar 1975).

The fraction of the α-particle energy absorbed in a reacting DT sphere by Rutherford interactions with ions and electrons is computed and compared to previous results obtained by neglecting interactions with ions. (auth)

29316 A NON-THERMAL PLASMALESS FUSION REACTOR FOR THE CONTROLLED GENERATION OF NUCLEAR FUSION ENERGY. Maglich, B. C. French Patent 2,181,858/A/. 2 Apr 1973. 37p. (In French).

A procedure for the production of power by nuclear fusion is described. A magnetic field is produced in a volume of space and this field decreases with radial distance from the central axis Z and increases with the distance from the central plane in order to induce precession and to exert radial and axial focussing forces on ions circulating in orbits at the interior of this volume of space. Ions of the same charge are injected in proximity to the center of symmetry of the magnetic field so as to produce fusion reactions by collisions between ions. (FR)

29317 C_3F_7I LASER INSTALLATION WITH RADIATION ENERGY 20 J AND PULSE DURATION 3.0 nsec. Gaidash, V. A.; Kirillov, G. A.; Kormer, S. B.; Lapin, S. G.; Shemyakin, V. I.; Shurygin, V. K. JETP Lett. (USSR) (Engl. Transl.); 20: No. 4, 107-108(20 Aug 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 4, 243-246(20 Aug 1974).

The possibilities and prospects of using optical decoupling in single-pulse iodine lasers were investigated. A radiation pulse of 3.0 nsec duration and 20 J energy was obtained with an installation consisting of a driving generator and a single-stage amplifier, with a total weak-signal gain ~10^6. (auth)

29318 PRELIMINARY ENGINEERING DESIGN OF A VENETIAN BLIND DIRECT ENERGY CONVERTER FOR FUSION REACTORS. Barr, W. L.; Burleigh, R. J.; Dexter, W. L.; Moir, R. W.; Smith, R. R. (Univ. of California, Livermore). IEEE Trans. Plasma Sci.; PS-2: No. 2, 71-92(Jun 1974).

The device described reclaims the energy lost by the reactor through leakage of charged particles. Energy selection is accomplished through the angular dependence of transmission through a system of ribbon grids resembling a venetian blind. In contrast to previously described converters in which the beam of ions from the reactor is expanded in a flat fan-like expander, the beam in this device is expanded in two directions in a conical expander. Problems of grid construction, radiation damage, grid heating, and vacuum pumping are discussed. A preliminary cost

estimate shows that for a power handled of 1000 MW, the cost for the direct converter is $110 million or $110 per kW of power into the direct converter. The efficiency is estimated to be 59% for a two-state collector and 65% for a four-stage collector. Further development of the basic concept could possibly raise the efficiency to as high as 75%. Optimized designs might increase the power handled by a factor of several without significantly increasing the unit cost, thus greatly lowering the cost/kW. (auth)

29319 CURRENT EXPECTATIONS FOR FUSION POWER FROM TOROIDAL MACHINES. Mills, R. G. (Princeton Univ., NJ). IEEE Trans. Power App. Syst.; PAS-93: No. 6, 1805-1809 (1974).

From IEEE Power Engineering Society winter meeting; New York (27 Jan 1974).

The rapidly increasing effort to solve the problems of the controlled release of nuclear fusion energy has been stimulated by recent maturation of the science of plasma physics, especially in one area—the confinement of plasma in closed magnetic fields. At the same time, significant experimental progress has been achieved with magnetic mirror machines, and a large toroidal theta pinch is under construction at Los Alamos. Enthusiasm is running high in groups working on laser-ignited fusion. Perhaps all of these approaches will lead to viable power systems. It seems to be generally accepted, however, that toroidal magnetic machines have the greatest probability of being first, if not the only approach, to succeed, and this paper restricts its attention to that category. Current theories correspond to experimental results in the laboratory, and predictions of these theories imply the possibility of successful thermonuclear reactors. At the same time increasingly more realistic studies of hypothetical fusion power stations carried out by laboratory, university, utility, and manufacturing personnel make them appear to be potentially of great economic interest. Serious problems still remain, but increasing government support leads many to expect a scientific feasibility experiment and a demonstration of thermonuclear burning of deuterium-tritium fuel before 1980. (auth)

Wave Phenomena

Refer also to abstract 29242.

29320 (AD-781510) NON-LINEAR EFFECTS IN ELECTROMAGNETIC WAVE PROPAGATION. Conference Proceedings No. 138 Presented at the Electromagnetic Wave Propagation Panel Symposium Held in Edinburg (Scotland) on 12-15 November, 1973. (Advisory Group for Aerospace Research and Development, 92 – Neuilly-sur-Seine (France)). May 1974. 400p. (AGARD-CP-138). NTIS $8.25.

Nonlinear effects came into great prominence recently in connection with experiments in which very large rf powers are radiated from the ground towards the ionosphere at a frequency below the F2 penetration frequency. The experiments show the excitation of parametric instabilities. There also seems to be some evidence of anomalous plasma rf resistivity, causing an increase in the absorption of radio waves reflected from the "heated" region. These experiments, their counterparts in laboratory plasma physics at microwaves and in CTR research at laser frequencies and the related theories are discussed. (GRA)

29321 (IPF-73-6) CONTRIBUTIONS CONCERNING THE EXPERIMENTAL INVESTIGATION OF ALFVEN WAVES IN AN ARC PLASMA. Mueller, G. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1973. 96p. (In German). INIS.

The propagation behavior and field structure of Alfven waves propagating along a cylindrical plasma column of an axially magnetized arc discharge have been studied and analyzed experimentally and theoretically. It is shown that an axial propagation of torsional Alfven waves is strongly influenced by the radial limitation of the plasma, and by the presence of neutral gas. The dragging of neutral gas with the wave motion in the plasma seemingly results in an increase in ion mass and thus also a lower effective ion cyclotron frequency – i.e. an enhancement of the Hall effect. Dispersion phenomena similar to those of ion cyclotron waves in fully ionized plasmas can be observed in the partially ionized plasma. The field structure of the wave is likewise so changed due to the stronger Hall effect that the wave does not only produce a shearing of the magnetic field lines but also a compression. An axial current in the plasma column whose magnetic field produces a torsion of the external homogeneous, axial magnetic field, also causes a doubling of the compressional and torsional component. This effect can be separated from the Hall effect since the phase level of the two effects is different. The radial profile of the amplitude and phase of the wave field is determined by the radial distribution of the electrical conductivity and density of the plasma. The field maximum is within the range of high conductivity, whereas an inhomogeneous density will result in curbed phase surface. The experiments have been carried out in the plasma of an arc discharge with currents of up to 3 kA in hydrogen and helium at pressures within the torr region. (CB)

29322 (IPP-4/77) EXCITATION OF PLASMA WAVES BY GAPS AND SLOW-WAVE STRUCTURES. Derfler, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Sep 1974. 48p. (AED-CONF-74-539-001). INIS.

From international school of plasma physics symposium on plasma heating in toroidal devices; Varenna, Italy (3 Sep 1974). 11 figs.; 18 refs. With abstract.

Maxwell's equations are solved for a cylindrical waveguide containing a magneto plasma with a prescribed density profile. A complete set of orthogonal azimuthal and radial modes, and their dispersion relations is obtained. Power flux and surface current are then used to define a power-equivalent R. F. plasma potential and a characteristic wave impedance for each mode. The result is applied to axisymmetric systems of plasma wave excitation consisting of a sequency of gaps in the waveguide, connected to circuits of any kind. The respective boundary value problems are reduced to the case of a single gap with surface currents and power equivalent plasma potentials prescribed at two locations left and right from the gap. The Green's function is obtained for that case and used to set up an integral equation for the electric field along a surface bounded by the gap. An approximate solution based on Schwinger's variational principle amounts to matching the admittances looking both ways through the gap. That gives three by three admittance matrices, one for each mode, which relate the surface currents and potentials at the prescribed locations and at the gap. These mode-equivalent T-junctions are then used in conjunction with Floquet's theorem to synthesize the system of a periodic array of gaps connected to an iterated circuit. The resulting coupled mode equation for Floquet's propagation constant shows that efficient transfer of power from the circuit to the plasma wave requires a close match of their phase velocities and—for broad band operation—also a close match of their group velocities. These criteria lead to the design of a slow-wave directional coupler, which is applicable in the appropriate frequency regions. Sample calculations show that these requirements are met by plasma waves in a frequency range between the lower-hybrid frequency and the electron plasma frequency. (auth)

29323 (NP-20328) CONDITIONS OF STRONG CYCLOTRON PLASMA WAVE INTERACTION. Anisimov, A. I.; Vinogradov, N. I.; Poloskin, B. P. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1975. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Some experimental and theoretical results of cyclotron interaction of microwaves with a nonuniform plasma are reported. The single-particle approximation is shown to be valid at small enough electron densities. The cyclotron interaction is accompanied by fast electron formation with energies 30 to 40 keV. In the experimental conditions, the width of the resonance curve is mainly determined by a relativistic shift of the electron cyclotron frequency. Conversion of the strong cyclotron absorption in a weak one with increasing plasma density is caused by a change of wave polarization and direction ange in a nonuniform plasma. (auth)

29324 INVERSE FARADAY EFFECT IN PLASMAS. Talin, B.; Kaftandjian, V.P.; Klein, L. (Centre St Jérôme, Université de Provence, 13013—Marseille, France). Phys. Rev. A 11: No. 2, 648-657 (Feb 1975).

The Kubo response—function formalism is utilized to obtain expressions for the magnetization created in a plasma by a circularly polarized electromagnetic wave. This effect, the inverse Faraday effect, has previously been studied only in the dipole approximation. The present treatment includes plasma polarization effects and allows consideration of the thermal motion and relativistic effects associated with high—powered laser radiation. A physical interpretation of the results is presented in which the angular momentum stored in the plasma is shown to be the basis of the effect. (auth)

29325 ENERGY TRANSPORT ACROSS A MAGNETIC FIELD BY PLASMA WAVES. Canosa, J.; Okuda, H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 18: No. 3, 335-345 (Mar 1975).

Cross—field energy transport by electrostatic plasma waves has been studied theoretically and numerically for a plasma near thermal equilibrium. Energy transfer by plasma waves is significant in a high temperature plasma where collisional transport is quite small. For strong magnetic fields ($\omega_c \gtrsim \omega_p$), the simulations verify the theoretical

prediction that energy transport by plasma waves increases slowly with the magnetic field, and that in the limit of large field magnitudes, wave transport dominates classical collisional transport. Furthermore, in a strong magnetic field the relaxation of the temperature by wave transport may result in an anisotropic velocity distribution. For weak fields ($\omega_p > \omega_c$), the simulation shows that collisional transport is more important than wave transport, also in agreement with the theory. (auth)

29326 SIMPLE APPROACH TO STIMULATED BACKSCATTERING IN INHOMOGENEOUS PLASMAS. Anderson, D.; Wilhelmsson, H. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Elektromagnetisk Faelltteori). Phys. Lett., A; 50: No. 5, 383-384(30 Dec 1974).

By means of a simple physical model an investigation into how the nonlinear backscattering occurring in laser-plasma interactions is affected by the presence of a density gradient is performed. The analysis reproduces in a direct way recent results for the inhomogeneity threshold and time of growth results which previously were obtained using considerably more sophisticated methods. (auth)

29327 COEFFICIENTS OF LIGHT ABSORPTION IN PLASMA. Romanov, G. S.; Stanchits, L. K.; Borovik, F. N. Zh. Prikl. Spektorosk.; 21: No. 3, 424-428(Sep 1974). (In Russian).

Problems are discussed concerning the nonideality of a plasma in calculating the absorption and average path of radiation with the use of the precise numerical solution of the Thomas–Fermi equation at $T \neq 0$. The effects of Coulomb interaction and degeneration are shown to exist in regions of 10^{23} cm^{-3} density and $T < 10$ eV. Rosseland average paths of the radiation in plasma ($Z = 10$) are shown as a function of density, and tables of the ionization composition of plasma are presented. (tr-auth)

29328 PARAMETRIC EXCITATION OF ALFVEN AND ACOUSTIC WAVES. Hung, N. T. (Ecole Polytechnique Federale, Lausanne, Switzerland). J. Plasma Phys.; 12: 445-453(Dec 1974).

The nonlinear interaction between two Alfven waves and a sound wave is studied, using the normal-mode approach. This leads, in a simple way to a set of coupled equations, and consequently to a dispersion relation for the waves under consideration. It is shown that a large-amplitude Alfven wave can give rise to two distinct types of parametric instabilities, namely the oscillating and the purely growing waves. In each case, the expressions for the threshold pump intensity, the frequency shift and the growth rate of the excited waves are obtained. In particular, the results for a propagating pump under perfect frequency matching conditions are compared with those of Sagdeev & Galeev (Sagdeev, R. Z. & Galeev, A. A., 1969, Nonlinear Plasma Theory. Benjamin). (auth)

29329 EFFECTS OF TRAPPED AND UNTRAPPED PARTICLES ON AN ELECTROSTATIC WAVE PACKET. Espedal, M. S. (Univ., Bergen). J. Plasma Phys.; 12: 487-500(Dec 1974).

A procedure to solve the Vlasov-Poisson equations for electrostatic wave packets is presented. A Schrödinger type of wave equation is obtained, taking the wave-particle interaction into account. This equation is used to study the propagation of one finite-amplitude wave packet. A change in amplitude is found caused by interaction between the packet and particles propagating near to the group velocity. A modulation of the plasma in the front of the packet, caused by trapping effects, is also found. (auth)

29330 GENERATION OF DRIFT WAVES BY AN RF FIELD NEAR THE LOWER HYBRID FREQUENCY. Baranov, Yu. F.; Bulyginskii, D. G.; Vil'dzhyunas, M. I.; Galaktionov, B. V.; Shustova, N. V. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 732-735(Dec 1974)

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1161-1167(June 1974).

The generation of drift-waves in an argon plasma by rf fields at frequencies near the lower hybrid frequency is studied. Within a single pulse the nature of the spectrum changes gradually from a monochromatic spectrum near the beginning of the discharge to a noisy spectrum at the critical plasma parameters, corresponding to an abrupt change in the regime. At this abrupt change an equally abrupt restoration of the monochromatic drift-wave spectrum is observed. It is also found that when added, the spectra of two neighboring probes become different, apparently implying nonlinearity of the drift wave. It is suggested that the observed turbulence leads to additional charged-particle loss and is one of the factors responsible for the cutoff of the absorption of the rf radiation by the plasma. (auth)

29331 HARMONIC FIELDS IN A NONUNIFORM PLASMA. Morrone, T. (Adelphi Univ., Garden City, NY). IEEE Trans. Plasma Sci.; PS-2: No. 3, 160-173(Sep 1974).

The magnitudes of the harmonic fields which are generated when an alternating electric field is applied to a plasma are calculated. The plasma has a density gradient and is immersed in a uniform static magnetic field. The harmonics are very strongly excited near the upper hybrid frequency. A fluid theory is employed to describe the highly nonlinear behavior near resonance and a kinetic theory is used to find the effect of a finite temperature. It is found that kinetic effects are important if the radius of gyration is comparable in size to the scale length. (auth)

29332 PROPERTIES OF PLASMA WAVES DEFINED BY THE DISPERSION RELATION $D(k,\omega) = 1 - \omega_0^2/\omega^2 + k_0^2/k^2 = 0$. Lonngren, K. E. (Univ. of Iowa, Iowa City); Hsuan, H. C. S.; Landt, D. L. IEEE Trans. Plasma Sci.; PS-2: No. 2, 93-108(Jun 1974).

This paper reviews four experimentally measured properties of waves which propagate in a media which has a dispersion relation $D(k,\omega) = 1 - \omega_0^2/\omega^2 + k_0^2/k^2 = 0$ where ω_0 and k_0 are characteristics of the media. A transmission line, ion acoustic waves, and electron plasma surface waves were examined and similarity was found in the properties. Differences that were found are also explained. (auth)

29333 HARMONIC EMISSION FROM TONKS–DATTNER RESONANCE: EXCITED AFTERGLOW PLASMAS. Rao, K. V. N.; Hayes, D. T. (Air Force Cambridge Research Labs., Bedford, MA). IEEE Trans. Plasma Sci.; PS-2: No. 2, 59-62(Jun 1974).

The decaying plasmas in neon and xenon were subjected to ~3 GHz absorption at "plasma resonance." The dependence of the second harmonic emission on the input excitation amplitude and neutral gas pressure is described. Low frequency amplitude fluctuations are also observed on the second harmonic amplitude. (auth)

ENGINEERING

Energy Conversion

29334 (MND-2062-03-7) SNAP 29 POWER SUPPLY SYSTEM, SECOND QUARTERLY PROGRESS REPORT. (Martin Marietta Labs., Baltimore, Md. (USA)). 28 Apr 1967. Contract AT(29-2)-2062. 304p. Dep. NTIS $18.25.

Declassified 30 Aug 1973.

Work accomplished during the period from Jan. to April 1967 in the development of the SNAP 29 battery is reported. Information is included on the radioisotope thermoelectric generator systems' reliability and safety evaluation, and progress in evaluating materials for the ^{210}Pu heat source capsule. (LCL)

29335 (MND-2062-3-8) SNAP 29 POWER SUPPLY SYSTEM, SIXTH QUARTERLY PROGRESS REPORT, JANUARY 1, 1968–MARCH 31, 1968. (Martin Marietta Labs., Baltimore, Md. (USA)). 19 Apr 1968. 323p. Dep. NTIS $19.25.

Declassified 31 Aug 1973.

Progress during the period from Jan. 1 to March 31, 1968 in the development of the radioisotope-fueled thermoelectric power supply system, SNAP-29, is reported. The design, fabrication, and testing of SNAP-29 components such as fuel capsules, thermoelectric elements, heat pipes, thermal control subsystem, and RTG housing are discussed. (LCL)

29336 (MND-2062-12-7) SNAP 29 POWER SUPPLY SYSTEM FIFTH QUARTERLY PROGRESS REPORT. (Martin Marietta Corp., Baltimore, Md. (USA)). Jan 1968. Contract AT(29-2)-2062. 262p. Dep. NTIS $16.25.

Declassified 30 Aug 1973.

Progress during the period from Oct. 1, to Dec. 31, 1967 in the development of the radioisotope-fueled thermoelectric power supply system, SNAP-29, is reported. The design, fabrication, and testing of SNAP-29 components such as fuel capsules, thermoelectric elements, heat pipes, thermal control subsystem, and RTG housing are discussed. (LCL)

29337 IMPEDANCE CHARACTERISTICS OF DIODES OPERATING IN THE SELF–PINCH MODE. Cooperstein, G.; Condon, J.J. (Naval Research Laboratory, Washington, D. C. 20375). J. Appl. Phys. 46: No. 4, 1535-1538 (Apr 1975).

The impedance characteristics of large aspect ratio diodes employing hollow field emission cathodes operating in the self–pinch mode have been studied at electron kinetic energies between 400 and 800 keV and currents between 100 and 500 kA. The importance of correcting the anode–cathode gap spacing for closure due to plasma motion is recognized and taken into account in the definition of the diode aspect ratio in impedance calculations. With this correction, the impedance at peak diode voltage and current is found to be nearly independent of voltage and cathode surface area, and inversely proportional to the diode aspect ratio. Its amplitude is approximately 50% higher than that predicted by parapotential flow theory. (auth)

29338 HIGH-PERFORMANCE EMITTER FOR THERMIONIC DIODES. Durand, J. P.; Gillardeau, J. (CEA, 75 - Paris (France)); Faron, Robert (Societe des Usines Chimiques, 26 - Pierrelatte (France)). (to CEA, 75 - Paris (France)). French Patent 2,186,706/A/. 2 Jun 1972. 9p. (In French).

A fissile fuel material is coated with at least one emitting layer deposited on its outer surface and adapted to strengthen the mechanical structure thereof, the deposition of said layer being carried out in an atmosphere consisting of hydrogen and of gaseous molybdenum and tungsten halides at a temperature of at least 1200°C and at a pressure of 1mm of mercury. The invention can be applied to the high-performance emitters adapted to equip thermionic diodes. (FR)

Facilities and Equipment

Refer also to abstracts 29155, 29615, 30117, 31757, 32062, 32248, and 32249.

29339 (ACF-431-119) CARE AND USE OF SEALS AND TUBE FITTINGS. (ACF Industries, Inc., Albuquerque, N. Mex. (USA)). 10 Apr 1965. Contract AT(29-1)-1352. 34p. Dep. NTIS $4.75.

A wide variety of seals and tube fittings are used on the Rover reactor and test car to prevent leaks in the system. The care and use of seals and tube fittings is a requirement common to the assembly of a reactor, test car, and reactor and test car. This manual contains the procedures for the care and use of seals and tube fittings and is an adjunct to published reactor and test car assembly manuals. It is issued for information of and use by LASL, WANL, and ACF personnel concerned with assembling reactors and test cars. (auth)

29340 (AGC-2711(Vol.1)(Bk.1)) E-MAD AND SUPPORT FACILITIES COMPLEX. Operations Data Book. Volume I. Book I. Summary. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Feb 1964. 149p. Dep. NTIS $10.50.

All pertinent information relative to the activation and operation of the Engine Maintenance Assembly/Disassembly (E-MAD) and Support Facilities Complex at the Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada is presented. In addition, general descriptions are provided of all facilities to provide a better understanding for personnel not familiar with the complex. General data is provided in Volume I and detailed data for each facility are provided in the other volumes and books of this report. (auth)

29341 (AGC-2711(Vol.2)(Bk.1)) E-MAD AND SUPPORT FACILITIES COMPLEX. Operations Data Book. Volume II Book I. Utilities. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Feb 1964. 36p. Dep. NTIS $5.00.

Preliminary data for the E-MAD and Support Facilities Complex is presented. The report is published for review and comment by those connected with the activation and operation of this complex. General and detailed data for all supporting utilities of the complex are included. (auth)

29342 (AGC-2711(Vol.3)(Bk.1)(Pt.3)) E-MAD AND SUPPORT FACILITIES COMPLEX OPERATIONS DATA BOOK. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Feb 1964. 319p. Dep. NTIS $19.00.

Data are presented on support facilities for the NERVA program Engine Maintenance, Assembly, and Disassembly facility (E-MAD). Information is included on air conditioning and environmental control systems, power supplies, gas and water supplies, waste disposal, radiation monitoring, remote handling equipment, remote control systems, etc. (LCL)

29343 (AGC-2742) ECONOMIC EVALUATION OF 21′–5″ AND 33′ DIAMETER LH_2 RUN TANKS FOR ETS-2. (Aetron, Covina, Calif. (USA)). Nov 1963. 46p. Dep. NTIS $5.50.

An evaluation of two liquid–hydrogen run tanks of different diameters was conducted for the purpose of determining the most economical design for Engine Test Stand No. 2 at NRDS Jackass Flats, Nevada. The results indicate that a test stand utilizing a 33-foot inside diameter LH_2 vessel (vacuum-jacketed) would cost approximately one hundred thousand dollars ($100,000) less than a test stand with a 21-foot–5-inch diameter vessel of equal capacity. (auth)

29344 (AGC-2988) ELECTRON BEAM WELDER UTILIZATION. (Aerojet-General Corp., Azusa, Calif. (USA)). Feb 1965. 9p. Dep. NTIS $4.00.

The capabilities, advantages, and uses of the electron beam welder at the von Karman Center of the Aerojet-General Cor are described. (LCL)

29345 (ANL-CT-75-28) ANALYSIS OF EXTENSIBLE CURVED PIPES CONVEYING FLUID. Chen, S. S. (Argonne National Lab., Ill. (USA)). Jan 1975. Contract W-31-109-eng-38. 29p. Dep. NTIS $4.50.

A linear theory is presented to account for the motions of extensible curved pipes conveying fluid. Hamilton's principle is used to derive the equations of motions and the boundary conditions. Based on the theory, the flow-induced deformations are obtained in closed form. The natural frequency is also studied, and it is shown that the frequency decreases with increasing flow velocity. As the velocity approaches a certain value, the pipe loses stability by buckling. The critical flow velocity is calculated for two types of pipe end conditions. (auth)

29346 (ANSC-T0F09-A814) RESEARCH SUGGESTION: AN INVESTIGATION OF FLUIDICS APPLIED TO TELEOPERATOR SYSTEMS. (Aerojet Nuclear Systems Co., Azusa, Calif. (USA)). Nov 1970. 58p. Dep. NTIS $6.00.

A program to investigate the application of fluidic technology, the slave portion of teleoperator systems, is outlined. The objective is to prove the feasibility of utilizing fluidic concepts and components to perform control functions for selected teleoperator subsystems. To achieve this objective, a two-phase effort is planned. The phases combine in defining the specific teleoperator subsystems and functions where fluidics can be most effective and conceiving and evaluating fluidic control circuits that can be used

effectively for both specific and general application, and, finally, in demonstrating a working teleoperator actuator subsystem based on use of fluidic components. This program provides a balanced investigation that will document the potential applications of fluidic technology to teleoperators and will afford experimental demonstration of the feasibility of basic fluidic teleoperator subsystem control. (auth)

29347 (LMEC-TDR-74-10) EVALUATION OF SPTF HEATER STANDOFF DESIGN. Armstrong, G. R. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 16 Dec 1974. Contract AT(04-3)-700. 98p. AT.

The results of a test program conducted to evaluate the heater standoff design to be used for Class A piping in the Sodium Pump Test Facility (SPTF) are described. A test assembly was fabricated, using a section of 16-in. pipe, and subjected to 11 thermal cycles between 400 and 1050°F. In addition, several changes were made to the assembly's outer jacket in an effort to lower the temperature of the outside surface. The heater standoff design showed no structural degradation. (auth)

29348 (MLM-2200(OP)) COMPUTER-CONTROLLED, THREE-AXIS, STEPPING-MOTOR DRIVE SYSTEM. Page, D. O.; Draut, C. F. (Mound Lab., Miamisburg, Ohio (USA)). [nd]. Contract AT-33-1-GEN-53. 6p. (CONF-750405-2). Dep. NTIS $4.00.

From IEEE southeast conference; Charlotte, North Carolina, USA (7 Apr 1975).

Mound Laboratory was delegated the responsibility to design and develop a prototype system for performing quantitative and qualitative analyses of samples containing plutonium-238. This system will serve as a model for private manufacturers who will be fabricating fuel elements for the atomic power industry and who will be accountable for all nuclear material released to them. The overall analytical system design required a computer-controlled, closed-loop, three-axis transport system for moving plutonium samples among various work stations in a helium-tight hood line. A control system of this description was not commercially available so its development was undertaken. A computer-controlled, three-axis, stepping-motor drive system was designed and developed to direct a three-dimensional (X,Y,Z) transport and position system which will mechanize and automate material transfer through process modules. This drive system will interface with most computers through a standard two-wire, serial ASCII, I/O module. (auth)

29349 (NTO-I-0144) TEST DESCRIPTION FOR COMPARTMENT EXPERIMENTAL PLAN ENGINE TEST COMPARTMENT (ETC) PURGE TESTS. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Apr 1967. 23p. Dep. NTIS $4.25.

The Engine Test Compartment (ETC) and associated purge system provide for a safe, oxygen-free operating environment for the NERVA engine prior to and following engine operation, and the ETC provides altitude simulation and radiation shielding during engine operation. ETC purge tests that will determine the optimum method for excluding oxygen from the ETC by the use of an inerting GN_2 purge are described. (LCL)

29350 (NTO-I-0304) ETO-EST-1 DATA HANDLING PLAN. Final Issue. Beeman, J. L. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 27 Oct 1967. 36p. Dep. NTIS $5.00.

A procedure for the handling of ETS-1 Engine Test Data by Nerva Test Operations (NTO) at NRDS is established and user interfaces are identified. This procedure will serve as a guide to site users in establishing their data requirements. This procedure describes various data, its processing, availability, reproduction and distribution. Information in this procedure relative to length of time to data availability is based on an assumed continuous 30 minute duration run. (LCL)

29351 (NTO-M-11255) TRANSMITTAL OF FDET MEMORANDA FOR EST-1 FEP-IIB AND IC. Maxon, B. S. (comp.). (NERVA Test Operations, Jackass Flats, Nev. (USA)). 22 Nov 1966. 224p. Dep. NTIS $14.25.

Thirteen reports on the performance of He and H_2 gas flow systems and the liquid nitrogen flow system in the NERVA Engine Test System-1 facility are presented. (auth)

29352 (NTO-M-14141) SPEAR TEAM REPORT, NEPN-1. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 24 Jun 1967. 168p. Dep. NTIS $11.50.

Analyses of test objectives, anomalies noted during the investigation, and recommendations as a result of the studies of the performance of the Exhaust Duct System (EDS) and the Engine Test Compartment (ETC) for the NERVA Program are summarized. (LCL)

29353 (NTO-R-0009) ETS-1 PROCESS WATER SYSTEM TEST PROGRAM REPORT. Henze, H. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 30 Oct 1964. 97p. Dep. NTIS $8.00.

Water flow tests were conducted during Sept. and Oct. 1964 to determine the validity of the water system modifications in vibration suppression and to test the new flow valve actuation system while simulating prototype NERVA Engine System (NES) duct cooling water flow and to determine system flow characteristics at the prototype NES duct cooling flow rate with the process water tank level at both maximum and minimum values while simulating the steam generator and shield water flow requirement. The modification of the flow control valve actuation system was completely satisfactory. High-frequency acceleration loads and large-amplitude low-frequency resonance of the process water piping, especially of the 36-in. return line, was noted. It was recommended that the return line be relocated and that flow control valves be installed. (LCL)

29354 (NTO-R-0082) STEAM GENERATOR DEVELOPMENT TEST PROGRAM, EXPERIMENTAL PLAN V. Test Report. McCarty, W. L. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Jul 1966. 56p. Dep. NTIS $6.00.

The ETS-1 Steam Generator System Development Test Program Experimental Plan V was conducted in March and April 1966. Each generator module was tested twice at full steam conditions while the other two generator modules remained at idle flow condition. The first full steam test for each module was scheduled for 15 s duration. The duration for the second full steam test was 120 s for Modules 0016 and 0017 and 180 s for Module 0018. On the full steam command, the injection water control valve was commanded to the maximum open position. The valve remained in the maximum open position for all 15 s runs. For the 120 s run on Module 0016 throttling was not employed because the low water supply pressure achieved the required steam temperature of 1100°F. During the 120 s run on Module 0017 and the 180 s run on Module 0018, the injection water control valve was adjusted to approximately 25% of the valve opening in order to achieve a revised steam temperature of approximately 1200°F. At the end of the 15 s runs the modules were manually shutdown. At the end of the 120 s runs and the 180 s run, the module operating at full steam was shutdown by closing the main stage liquid oxygen valve which initiated a "low steam pressure cutoff" malfunction terminating the run. Except for minor discrepancies, the Steam Generator System operated satisfactorily throughout the test. Upon completion of the test series, the modules were disassembled and inspected and found to be in good condition. (auth)

29355 (NTO-R-0096) ETS-1 OPERATOR QUALIFICATION GUIDE. Banerjee, M. K. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Oct 1966. 121p. Dep. NTIS $9.25.

This manual was prepared for the training and qualifying of Engine Test Stand control room operators. The requirements for qualification of each operator are itemized and a description of his duties is included. Through classroom instruction and on-the-job training, trainees learn the general background information and the specific practical factors needed for qualification. Operators are also required to demonstrate a degree of technical competence in keeping with the demands of his operating position. This training program is to provide personnel who are skilled in the safe and proficient operation of this test facility. Before being officially qualified, a trainee must demonstrate his full knowledge of the facility and his ability to operate and control the systems related to his position. (auth)

29356 (NTO-R-0101) ETS-1 GENERATOR EXPERIMENTAL PLAN VIII. Venturi Calibration Test Program. McCarty, W. L. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 13 Dec 1966. 25p. Dep. NTIS $4.25.

The purpose of the Generator Experimental Plan VIII (GEP-VIII) was to provide operational and flow measurement data for eight Steam Generator System (SGS) liquid propane main-stage venturis. One main-stage venturi is installed on each steam generator module. The venturis are designed such that cavitation occurs at the venturi throat and limits the propane flow rate to the main combustion stage. The test objectives were to: determine the flow coefficient (K) of each propane venturi and to determine the cavitating and non-cavitating region of the venturis. Eight venturis were flow tested with propane, in sequence, by maintaining a constant inlet pressure and decreasing the outlet pressure to a minimum value. Four inlet pressures were used for each venturi calibration test. The test results for each venturi were in close agreement between the various inlet pressures and with venturis of the same nominal size. When compared with previous calibrations, the test results showed that the mass flow rate was actually less for a given inlet pressure and temperature. (auth)

29357 (NTO-R-0114) XE-1 COOLDOWN HARDWARE, A RELIABILITY STUDY AND RECOMMENDATION. Hanlen, D. F.; Booty, W. F.; Glasbergen, G.; Mitchell, J. W.; Paolucci, A. J. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 30 Jun 1967. 85p. Dep. NTIS $7.25.

The findings and recommendations of the ETS-1 Valve Task Force concerning the capability of the existing electrical and valve actuation systems of the ETS-1 facility to provide adequate cooling to the XE-1 Engine in the event of a single system malfunction are presented. This is not intended to be a comprehensive failure mode analysis of the ETS-1 facility; rather, it represents a step in a series of steps which one should take to ensure that the engine and facility remain functional following any single failure of the following systems: instrument ac power distribution bus; essential ac power distribution bus; 28 volt dc system; GN_2 valve actuation supply system; and hydraulic power supply system. (auth)

29358 (NTO-R-0121) TEST STAND AUXILIARY SYSTEMS CHECKOUT REPORT. Final. Brandt, H. W.; Davis, G. A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 13 Sep 1967. 38p. Dep. NTIS $5.00.

Data acquired during the checkout of three auxiliary systems, i.e., the remote disconnect actuators system, the engine valve actuation system, and the engine and turbopump assembly purge line system, for regulating gas flows for the NERVA program Engine Test Stand are presented. (LCL)

29359 (NTO-R-0125) ETS-1 STEAM GENERATOR SYSTEM IMPROVEMENT TEST PROGRAM. McCarty, W. L.; Henze, H. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 78p. Dep. NTIS $7.00.

The ETS-1 Steam Generator System Improvement Verification Test Program, consisting of seven tests, was conducted between December 1966 and February 1967. Because of ETS-1 scheduling constraints, the majority of the verification tests initiated in the GEP IX test series were incorporated and completed during the NES Phase I Design Demonstration Test Program. This primarily was a result of an ignitor failure during GEP-IX-2 which resulted in a one-month program delay for rebuilding and evaluation purposes. The test objectives were generally satisfactorily accomplished and for the first time during the Steam Generator Testing program completely successful generator switching was demonstrated. Steam line problems were encountered and although the test program was successfully concluded these were of such a serious nature that additional modifications must be incorporated prior to any additional use of this line. (auth)

29360 (NTO-R-0153) ETS-1 TEST PREDICTION SUMMARY REPORT FOR FACILITY EXPERIMENTAL PLAN V. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 18 Jul 1968. 191p. Dep. NTIS $12.75.

Significant test predictions in support of the Facility Experimental Plan V (FEP-V) are summarized. The information presented is based on latest NRO analog runs, latest NTO predictions, and the specific references listed. The analog model used for the predictions is described. This information is primarily to aid Engine Test Operations (ETS-1) personnel during the planning and conductance of FEP-V, and to aid the Facility Data Evaluation Team (FDET) during the post-test data analysis. The predicted performance characteristics of the LN_2, the high pressure LH_2, the high pressure GHe and the high pressure GH_2 cooldown systems are included. (LCL)

29361 (NTO-SOP-0193) "MIRACLE" PROGRAM (REAL TIME): OPERATING INSTRUCTION FOR CDC 3200/DATA LINK-SETUP, CHECKOUT AND OPERATION. Arnold, H. Y. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 20 Nov 1968. 5p. Dep. NTIS $4.00.

A procedure is presented for the setup and operation of the real time program "MIRACLE" on the CDC 3200 during operation of the Engine Test Stand (ETS-1). (LCL)

29362 (NTO-T-0007) ETS-1 CONSOLE OPERATIONS MANUAL. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1967. 57p. Dep. NTIS $6.00.

The Facility Engineer–Right (FER) console is used to set up and monitor the following test stand operations: controls for pressurizing, venting or discharging liquid from either the LH_2 storage dewar, V-3801, or from the LN_2 storage dewar, V-3601; igniting three separate flare stacks; control of emergency actuation gas supply to solenoid pilot valves, vacuum pump control on VP-3801 and VP-5001; and control of LH_2 run tank topping. In addition to the above systems, the FER has numerous monitoring assignments such as, vessel vacuum indication, oxygen and combustible gas concentration in the flare systems, and various overpressure alarms. This manual provides operation information about the FER console, and discusses in detail subsystems controlled from this console. (auth)

29363 (NTO-T-0013) ETS-1, CONSOLE OPERATIONS MANUAL. Test Stand Engineer. McConnell, R. J. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 30 Jun 1967. 90p. Dep. NTIS $7.50.

This manual provides the basic knowledge required to operate the Test Stand Engineer (TSE) console. The TSE console is designed to control and monitor the supply of cooldown fluids to the engine during emergency and normal shutdown conditions. All fluids entering the engine system, other than the LH_2 flowing through the run tank, must pass through one of the systems on the TSE console. Five basic flow systems are provided; liquid hydrogen, gaseous hydrogen, helium, liquid nitrogen, and gaseous nitrogen. Flow diagrams of all the instrumentation and controls appearing on this console are included. Detailed descriptions of the controllers and the control schematics are also included. The operational procedures for the various cooldowns are discussed. This manual does not attempt to provide maintenance or checkout information. (auth)

29364 (RN-DR-0038) HEAT TRANSFER INVESTIGATION OF EJECTOR SYSTEMS WITH 90° TURNS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1964. 24p. Dep. NTIS $4.25.

Results are presented from a test program that evaluated the heat transfer characteristics of a series of ejector systems that turned the rocket exhaust gases through 90°. The ejector systems covered a range of designs that utilized both subsonic and supersonic turning of the gases within a fixed height. A series of tests with heated nitrogen was made for each ejector, during which measurements of local pressures and wall temperatures were made to provide the data necessary to evaluate the heat-transfer conditions. The results from three of these systems are discussed in detail to illustrate the differences in thermal behavior that can be obtained during the turning of the gases. The maximum heating rate was reduced by a factor of 7 when the ejector had a long radius, as compared to a short radius 90° turn and by a factor of 5 by permitting the gases to shock down to subsonic flow prior to entering the short radius bend. A method of converting the scale-model heat-transfer coefficient data to any other scale size, working fluid, nozzle chamber temperature or chamber pressure and an empirical correlation of the maximum heating rates is presented. (auth)

29365 (RN-DR-0193) 64" NASS DUCT GRAPHITE LINER/COOLANT PASSAGE EVALUATION, 6 WEEK STUDY. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1970. 362p. Dep. NTIS $21.25.

Graphic material is presented that represents the results of the six-week evaluation of a 64-in. NASS primary ejector liner and various coolant passage configurations to meet the cyclic life requirements at the operating temperature and pressure. The scale model test and analysis effort, conducted to provide aerodynamic and heat transfer data, is also presented. Supplementary supporting documentation developed during the study is included. (auth)

29366 (RN-S-0082) SUPPORT EQUIPMENT TECHNICAL DESCRIPTION HANDBOOK. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1964. 511p. Dep. NTIS $28.75.

Each piece of support or auxiliary equipment, i.e., tools, handling and storage devices, measuring and testing instruments, containers, oil filters, etc., required for testing the NERVA engine is catalogued with a brief description, item number, drawing number, and some tabulated operating data. (LCL)

29367 (RN-S-0314(Rev.C)) PART C: ETS-1 ENGINE INSTALLATION SPECIFICATION. (Aerojet-General Corp., Sacramento, Calif. (USA)). 27 Feb 1968. 19p. Dep. NTIS $4.00.

Specifications are presented for the following items related to the use of the Engine Test Stand (ETS-1) for testing the XECF engine: transport of engine to ETS-1; installation of engine in ETS-1; and engine checkout requirements at ETS-1. (LCL)

29368 (RN-TD-0012) DEMONSTRATION TEST REPORT FOR X-ENGINE SYSTEM. 3/8 Inch–3 Way Marotta Solenoid Valve Model No. 583KC, P/N 806235. Dorian, J. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 10p. Dep. NTIS $4.00.

The $\frac{3}{8}$ in.–3 way Marotta valve Model No. 583KC, P/N 806235 is solenoid-operated and incorporates Mylar seats and Mylay/Kel-F dynamic shaft seals for GHe service. The solenoid valves are used as pilot valves in the X-engine pneumatic supply system for operation of the 4, 5, and 8 in. valves that have piston actuators. The solenoid valves control the flow of 520°R, 500 psig gaseous helium to the piston type actuators. Minimum environment temperature for the valves will be 140 to 190°R GN_2. The demonstration procedures conducted were successful in indicating the capability of the valve in accordance with the acceptance criteria. On the basis of these results, the valves to be delivered

for use in the X-engine systems will be the same design configuration. (TFD)

29369 (TID/SNA-130) ETS-1 OPERATIONS SUMMARY REPORT FOR PERIOD 1963–1969. Volume I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 221p. Dep. NTIS $14.25.

Engine Test Stand No. 1 (ETS-1) operations, covering the period from test stand beneficial occupancy date in 1963 through the XE test series in 1969, are summarized. This information provides: justification for additional ETS-1, E-MAD, SETS, and MCC/EIV modifications that have previously been undefined or unfunded; a source of historical information; a means for key operational personnel to submit comments and recommendations on previous operational problems; and a learning device to translate ETS-1 XE engine experience into NERVA application. Seven broad categories of tests have been performed at ETS-1 since the beneficial occupancy date (BOD) of May 24, 1963 and include the following categories of testing: experimental engine (XE); experimental engine cold flow (XECF); facility experimental plans (FEP) I-IV; facility experimental plan V; facility checkout (FCO) tests; facility modifications and checkouts; and nuclear exhaust system. Activities in the first four categories are reported in this volume. (LCL)

29370 (TID/SNA-131) ETS-1 OPERATIONS SUMMARY REPORT FOR PERIOD 1963–1969. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 233p. Dep. NTIS $14.75.

Engine Test Stand No. 1 (ETS-1) operations, covering the period from test stand beneficial occupancy date in 1963 through the XE test series in 1969, are summarized. This information provides: justification for additional ETS-1, E-MAD, SETS, and MCC/EIV modifications that have previously been undefined or unfunded; a source of historical information; a means for key operational personnel to submit comments and recommendations on previous operational problems; and a learning device to translate ETS-1 XE engine experience into NERVA application. Seven broad categories of tests have been performed at ETS-1 since the beneficial occupancy date (BOD) of May 24, 1963 and include the following categories of testing: experimental engine (XE); experimental engine cold flow (XECF); facility experimental plans (FEP) I-IV; facility experimental plan V; facility checkout (FCO) tests; facility modifications and checkouts; and nuclear exhaust system. Activities in the last three categories are reported in this volume. (LCL)

29371 (TID/SNA-296(App. B)) NERVA ALTITUDE SIMULATION SYSTEM EXHAUST DUCT. Preliminary Structural Analysis. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. Contract SNP-1. 271p. Dep. NTIS $16.75.

The preliminary structural analysis of the NASS EDS was conducted and is submitted as Appendix B, in partial fulfillment of the NERVA Work Statement, NASS Project 224, Suffix f, Paragraph 3.a.(3). The primary ejector cyclic life of 800 cycles is less than the required 1000 cycles. The uncooled collar cyclic life was not calculated, due to lack of material property data. The design criteria require a collar life of 60 cycles. As specified in Data Item F008, all formulas are written with each parameter defined. Formulas and applicable codes are referenced. All calculated margins of safety are positive. Additional analyses required for combined loading conditions will be completed prior to Final Design Review. (auth)

29372 (TID/SNA-345) NERVA TPA AND VALVE TEST FACILITIES ALLOCATION AND COST STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. Contract SNP-1. 94p. Dep. NTIS $7.75.

Two locations, the "H" area in Sacramento and TC "C" at the NRDS, were considered for turbopump assembly (TPA) flow testing. Total estimated costs for the 42 month program are given. TPA tests are allocated to TC "C" on a cost and performance basis. (auth)

29373 (TID/SNA-642) ETS-1 OPERATIONS SUMMARY REPORT FOR PERIOD 1963–1969. Volume I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 221p. Dep. NTIS $14.25.

Engine Test Stand No. 1 (ETS-1) operations, covering the period from test stand beneficial occupancy date in 1963 through the XE test series in 1969, are reported, and a summary of data on ETS-1 operations is provided. (LCL)

29374 (TID/SNA-826) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Material Selection, Quality Assurance, and Fabrication Evaluation. Appendix G. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 28p. Dep. NTIS $4.50.

The Recommended Materials Selection for the NERVA Exhaust Duct System (EDS) is discussed. In general, stainless steel is recommended to provide reliability and durability for the long, unattended life requirements of the duct, as well as for its high heat resistance and for its moderate effects from the radioactive environment. A graphite fiber composite is recommended for an uncooled collar which is removable from the upper end of the duct for engine installation and removal. Certain other materials are recommended for special application, such as bearings, trunnions, etc. The Quality Assurance Evaluation summarizes the reviews and comments on the EDS design and fabrication specifications and the drawings as they evolved. The comments submitted were incorporated in these documents to reflect the requirements of the Quality Assurance plans and objectives as established for NERVA Facility Equipment. The Fabrication Evaluation identifies the fabricability of the EDS design as feasible and includes a summary of potential fabrication problems which should be given further consideration. The latter includes weld dimensions, general tolerance considerations, the plenum support ring design, etc. The proposed EDS Installation and Removal Sequence projects a handling scheme based on the EDS component design and assembly concepts. (auth)

29375 (TID/SNA-827) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design. Preliminary Dynamic Analysis. Appendix C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 46p. Dep. NTIS $5.50.

The preliminary dynamic analysis for the NERVA Altitude Simulation System (NASS) Exhaust Duct System (EDS) was conducted. This analysis resulted in the establishment of the dynamic model and the determination of the natural frequencies and mode shapes of vibration for the NASS duct. The dynamic model includes the primary ejector, turning plenum, secondary ejector, and subsystems' components attached thereto. The fundamental frequency of vibration is 7.45 Hz (T = 0.134 sec) and occurs as a half-wave mode shape in the secondary ejector. (auth)

29376 (TID/SNA-884) NERVA BEARING POST-TEST INVESTIGATION FOR 1138146-1 FROM LH_2 INDUCER TEST RIG FOLLOWING EP-2. Koch, D. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Feb 1972. 266p. Dep. NTIS $16.50.

Data sheets are presented from measuring the contact angle of 65 mm ball bearings following testing of the NERVA engine bearings in their race supports. (LCL)

29377 (TID/SNA-1014) FACILITY MALFUNCTION ANALYSIS REPORT FOR NERVA LH_2 PUMP COMPONENT DEVELOPMENT TEST AT TEST CELL C. Appendix A. (Aerojet-General Corp., Jackass Flats, Nev. (USA)). 9 Nov 1971. 75p. Dep. NTIS $6.75.

The Facility Malfunction Analysis performed by NRTO in support of the LH_2 Pump Component Development Tests to be performed at Test Cell "C" is described. The test facility malfunction analysis presented herein is limited to consideration of the cause and effects for single failures of facility system components whose failure could have a direct effect on the safety of critical test system hardware. Information is included on the Test System Protection Features, Test Facility Failure Analysis and Test System Operating Limits. The detailed descriptions of the test system, the test operations to be performed, the test limits to be enforced during test operations, and the test system setup requirements are given in the test description. (auth)

29378 (TID/SNA-1154) ETS-1 EXHAUST DUCT COOLING WATER STUDY. (Braun (C. F.) and Co., Alhambra, Calif. (USA)). Nov 1967. 32p. Dep. NTIS $4.75.

The use of raw water in the ETS-1 exhaust duct cooling system was studied. The ETS-1 facility is presently designed to use demineralized water with dichromate corrosion inhibitor. After passing through the system, the water discharges to the desert. There is concern that the non-biodegradeable dichromate inhibitor will pollute the underground water at the site, and there is an economic incentive to use raw well water. As a result of the initial study, it was concluded that no fouling could be tolerated if the design criteria, on maximum temperature of the duct wall, was to be met in the elbow section. In the absence of any fouling data at the surface temperature, heat fluxes, water velocities, and short exposure times encountered in the ETS-1 operation, it was concluded that untreated raw water should not be used for cooling the exhaust sections. If the well water salts were within certain ranges, it is recommended that a softening treatment be used instead of deionization, that the dichromate inhibitor in ETS-1 cooling water be replaced by a degradeable inhibitor, that additional water analysis be performed, and that short term fouling and corrosion tests be conducted at the expected values of heat flux, surface temperature, and water velocities. (auth)

29379 (TID/SNA-1162) INLET DESIGN CONSIDERATIONS FOR A LIQUID HYDROGEN PUMP. Vanica, D. F.; Beveridge, J. H. (Aerojet-General Corp., Azusa, Calif. (USA)). [nd]. 21p. Dep. NTIS $4.25.

From Crogenic engineering conference; Boulder, Colorado (19 Aug 1963).

The application of liquid hydrogen as a working fluid for rocket engine powered vehicles has been considered by industry for some time. Its low temperature as compared with that of normal surroundings will almost always cause boiling due to heat leakage. This situation has presented problems in the design of pumping systems because of the limited or even non-existent net positive suction pressure at the inlet to the pump. In actual operation, hydrogen pumping systems have demonstrated better suction performance than normally expected. A temperature-entropy diagram for hydrogen shows why performance is better and the lack of sufficient net positive suction pressure may not be as critical if the pump has proper design. A method of designing the inlet of a liquid hydrogen pump by considering the thermodynamic energy available from an isentropic expansion of the saturated liquid is presented. Also, the design of a specific liquid hydrogen pump is discussed. (auth)

29380 (TID/SNA-1172) NES DUCT SUB-SCALE THERMAL STRESS STRUCTURAL TEST PLAN. Brode, D. M. (Aerojet-General Corp., Azusa, Calif. (USA)). Sep 1963. 20p. Dep. NTIS $4.00.

A plan is outlined for testing the Exhaust Duct System in the NERVA engine test facility in order to verify that the coolant channels of the Exhaust Duct System are capable of withstanding the mechanical and thermal stresses developed during engine operation. The specific objectives of the program include: demonstration of the structural integrity of the structure under the maximum combined mechanical and thermal stresses; establishing a minimum cyclic strain capability of thirty cycles for the structure under repeated mechanical and thermal loads; correlation of experimental and theoretical data; and evaluation of tubular channel weld configurations. (LCL)

29381 (TID/SNA-1177) STUDY OF MODIFICATIONS FOR AN OPERATIONALLY INDEPENDENT TEST CELL A. (EG and G, Inc., Boston, Mass. (USA)). 16 Mar 1962. 350p. Dep. NTIS $20.50.

To properly estimate modifications, the existing instrumentation and control system of Test Cell A are described. Capacities for making various measurements are outlined and major equipment tabulated. Support system capabilities are discussed and the various reactor and facility control functions described. The interference problem is evaluated on the basis of the present non-independent design. This is followed by an analysis of the situation if a new recording facility were provided—as would be required for complete independence. Investigation of these two conditions enables one to extrapolate to other variations which might be suitable. Finally, a comparison of probable costs for the two approaches and their corollaries is provided. (auth)

29382 (TID/SNA-1194) ETS-2 DUCT PROPOSAL. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1963. 33p. Dep. NTIS $4.75.

Results of tests made to evaluate the design of the exhaust duct for the NERVA engine test stand are presented, and design modifications proposed. (LCL)

29383 (TID/SNA-1232) GAS DYNAMICS FORCES ON NES-1 DUCT. Breen, B. P. (Dynamic Science Corp., South Pasadena, Calif. (USA)). 23 Oct 1964. 24p. Dep. NTIS $4.25.

For Aerojet-General Corp., Azusa, CA.

In order to determine the vibration response of the NES-1 duct, estimates as to the forces causing vibrations were required. For the duct structure these forces are attributed to accelerations (change in velocity or direction) in the gas flow. Methods for extrapolating gas model test data are developed and subsequent scale model flow tests analyzed. Fluctuating forces are determined such that they can be applied directly to the model developed in the structural dynamics analysis program. (auth)

29384 (TID/SNA-1233) DYNAMIC RESPONSE OF NES (ETS-1) DUCT TO ENVIRONMENTAL FORCES. Final Report. Schjelderup, H. C.; Bell, A. W.; Soot, H.; Ball, R. E. (Dynamic Science Corp., South Pasadena, Calif. (USA)). 23 Oct 1964. 56p. Dep. NTIS $6.00.

For Aerojet-General Corp., Azusa, CA.

A summary of the dynamic response of the NERVA program Engine Test Stand-1 (ETS-1) duct to environmental forces is presented. Basic dynamic relationships are summarized. Coefficients are presented which allow rapid calculation of response parameters such as deflection, shear, and bending moment due to a deterministic or random loading condition. Example calculations are presented. Response of the duct is calculated using three different estimates of the environmental forces derived from one-quarter scale gas dynamics tests. Results of the transient dynamic response digital computer program using an environment measured directly from one-quarter scale gas dynamics tests is presented, and compared to the other three calculations. All four methods show the duct remains within design stress limits. Two appendices are attached. The first contains the first 16 mode shapes and modal characteristics obtained from the eigenvalue/eigenvector digital computer program. The second appendix contains the mathematical model parameters used as input data to the flexibility matrix program and the eigenvalue/eigenvector program. (auth)

29385 (TID/SNA-1234) TORSIONAL VIBRATION OF ETS-1 EXHAUST DUCT. Final Report. Ball, R. E.; Schjelderup, H. C.; Bell, A. W.; Soot, H. (Dynamic Science Corp., South Pasadena, Calif. (USA)). 22 Dec 1964. 34p. Dep. NTIS $4.75.

For Aerojet-General Corp., Azusa, CA.

The essential equations and results are presented of an analysis for the torsional vibrations of the NERVA Engine Test Stand-1 exhaust duct. The duct is supported at four locations by a very stiff truss framework. In addition to the truss supports, a bellows spring and a water seal bellows are attached to the duct, and several water pipes are attached to the manifolds. In order to assess the behavior of the duct alone, the assumption was made that the truss framework provided a rigid support at each of the points of attachment and that all the other attachments except the bellows spring could be neglected. In this analysis the duct has been modeled as a lumped parameter structure, and the natural frequencies and mode shapes of the duct were obtained using an Aerojet Eigenvalue program. Both stiffness and flexibility matrices were used in the governing equations to take advantage of the most convenient form of development. (auth)

29386 (TID/SNA-1235) DESCRIPTION OF THE HYPERTHERMAL ENVIRONMENT SIMULATOR (HES). A One-Megawatt Plasma Generator Facility. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1965. 22p. Dep. NTIS $4.25.

The Hyperthermal Environment Simulator (HES), a high-pressure one-megawatt plasma generator facility, was developed to produce a controlled rocket engine combustion environment. The design and operation of the HES are discussed. Its instrumentation system is described. Operation of the HES as it is currently designed is limited to subsonic, sonic, and low (Mach 1 to 2) supersonic flow. Typical HES applications and the performance achieved are listed. (LCL)

29387 (TID/SNA-1239) SPECIFICATIONS FOR ETS-1 STEAM GENERATOR SYSTEM. (Aetron, Covina, Calif. (USA)). 25 May 1964. 204p. Dep. NTIS $13.25.

Specifications for the NERVA Engine Test Stand-1 Steam Generator System are presented and cover: demolition and removal of existing structures; earthwork; concrete; structural steel and miscellaneous metalwork; protective and general painting; process piping; ventilating system; pressure vessels; electrical work; pneumatic, electrical and mechanical instrumentation; crane and hoist; excavation, trenching, and backfilling for utilities and piping; drain lines; fire protection system; and government-furnished equipment. (LCL)

29388 (TID/SNA-1249) NNRDC ENGINE TEST STAND EXHAUST SYSTEM HOT-FLOW SCALE TEST PROGRAM AND STRUCTURAL DESIGN STUDIES AND TEST. (Aerojet-General Corp., Azusa, Calif. (USA)). Jan 1962. 96p. Dep. NTIS $8.00.

A testing program developed to obtain additional data for the successful design of the Engine Test Stand (ETS-2) exhaust duct system to be used for the full-scale testing of the NERVA engine is discussed. (LCL)

29389 (TID/SNA-1281) HYDRAULIC ANALOGY TEST OF THE ENGINE TEST STAND-1 DUCT CONFIGURATIONS, FINAL REPORT. Kershner, D. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1963. 99p. Dep. NTIS $8.00.

The purpose of the hydraulic analogy tests was to visualize, two-dimensionally, the flow phenomena and shock patterns occurring in the ten proposed Engine Test Stand-1 duct configurations. Data were recorded on six of the ten tests and an analysis was performed on two of these ducts. Pressure profiles along the duct wall, calculated from the hydraulic analogy data, indicated the locations of severe heat transfer to the duct walls. These pressure profiles were also compared with subscale hot firing data of the actual ducts. The photographs taken of the flow pattern in the ten proposed ducts indicated that the large radius duct of test 3 (Ejector Number 2), will have the minimum of heat transfer problems. This conclusion was based on the mild shock pattern of duct 3

(Ejector Number 2) in comparison with the severe shock patterns in the abrupt turns of the other ducts. It was observed during testing that by inserting a proper size restrictor after the elbow, it is possible to drive all of the ejector configurations subsonic after the convergent section. The large radius duct of test 3 (Ejector Number 2) (Figure 3) is recommended if a supersonic duct is desired. It is also recommended that a subsonic duct be tested to see if an increase in duct performance and decrease in heat transfer can be obtained. The final choice of duct geometry should be tested on the water table to better determine possible heat transfer or performance problems. (LCL)

29390 (TID/SNA-1299) ENGINEERING OPERATIONS REPORT: LH_2 PUMP TEST RIG STRUCTURAL ANALYSIS. Rock, A. O. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 26 Nov 1971. 8p. Dep. NTIS $4.00.

A steady-state structural analysis of all the significant components of the LH_2 Pump Test Rig is presented. The calculated minimum margins of safety for each subcomponent are given. All the margins are equal to or greater than zero. No structural problems are anticipated in the operation of the LH_2 Pump Test Rig. (auth)

29391 (TID/SNA-1306) REMOTELY OPERATED TEST EQUIPMENT FOR MATERIALS TESTING AT COMBINED CRYOGENIC AND NUCLEAR RADIATION ENVIRONMENT. Weleff, W.; McQueen, H. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Nov 1965. 34p. Dep. NTIS $4.75.

The major design features of a remotely operated test equipment for testing of materials in a combined environment of liquid hydrogen and nuclear radiation are presented. This equipment consists of tensile pulling assemblies, cryostats, pneumatic and hydraulic systems and the necessary instrumentation. Description of this equipment and comments on the operating procedures are made. The equipment was utilized to obtain tensile and shear strength properties of various alloys in this environment. The raw data obtained is exceptionally good and corresponds to data obtained with standard tensile test equipment. (auth)

29392 (TID/SNA-1316) INSTRUMENTATION FOR CRYOGENIC TEMPERATURE MEASUREMENTS OF THE NERVA TURBOPUMP ASSEMBLY BEARINGS DURING NON-NUCLEAR STATIC TESTING. Farnham, J. W.; Chandon, H. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). 19 Nov 1963. 70p. Dep. NTIS $6.50.

Three types of thermocouples have been developed to measure the temperature of the bearings in the NERVA turbopump assembly. When used with a resistance temperature transducer, gold-cobalt vs copper thermocouples are recommended for post experimental computation of the temperatures because they yield the most accurate data. Chromel vs alumel thermocouples, although less sensitive, are recommended to measure the bearing temperatures during the NERVA turbopump test runs and to indicate kill parameters. Copper vs constantan thermocouples are the least sensitive and will require more development before they are practical. They can be used but are not recommended at this time. The output conversion data of the three types of thermocouples is reported in both tabular and graphical form. The theoretical accuracy and dynamic precision for all three types of thermocouple systems are discussed. (auth)

29393 (TID/SNA-1334) CRYOGENICS FOR NUCLEAR ROCKET APPLICATION. A Course for Technical Personnel Concerned with the NERVA Program. Book 2. Course Notes. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Jun 1962. 174p. Dep. NTIS $11.75.

A manual is presented for the safe handling and storage of liquid hydrogen at the Los Alamos Scientific Laboratory. (LCL)

29394 (TID/SNA-1336) SPECIAL TEST EQUIPMENT (S.T.E.) AND OTHER GOVERNMENT PROPERTY (O.G.P.) AT THE LIQUID ROCKET PLANT. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Aug 1963. 49p. Dep. NTIS $5.50.

The status of fabrication and construction of Special Test Equipment, including the Engineering Cryogenics Laboratory, Test Zone C and Test Zone H, for the NERVA rocket testing program is presented. (LCL)

29395 (TID/SNA-1361) ETS-1 WATER CALIBRATION TEST REPORT. Christenson, J. F. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 3 Feb 1964. 35p. Dep. NTIS $4.75.

Two water flow tests conducted from the 2,500,000 gallon process water tank, T3302, through the 42" water line and flow control valves and piping located in the pipe chase adjacent to the Engine Test Stand-1 duct vault are described. These tests were performed to determine the integrity and stability of the system under pressure conditions and to collect sufficient data to obtain a flow calibration to determine the adequacy of the water system for the exhaust duct, the proposed steam generator, and any other requirement for process water cooling. It was concluded that the installation of orifices eliminated a major portion of the noise and vibration with the flow control valve 50-FCV-32 fully open. This vibration, although substantially reduced from that experienced in the initial flow test, is still considerable manifesting itself in excessive movement of the 36" duct return line, the 42" drain line and the flow control valve area. It was further concluded that any future testing to obtain additional vibration or unstable flow data must be conducted with electronic instrumentation to be of any value. (LCL)

29396 (TID/SNA-1367) RESULTS OF THE BRAZE DEVELOPMENT PROGRAM CONDUCTED BY THE MARQUARDT CORPORATION FOR THE NERVA REGENERATIVELY-COOLED ROCKET NOZZLE, SIMULATED SECTION NO. 1. Report 15086. Creer, R. Y. (Marquardt Corp., Ogden, Utah (USA)). 2 Jan 1964. 12p. Dep. NTIS $4.00.

The Aerojet-General Corporation has contracted the Marquardt Corporation to fabricate and deliver one regeneratively-cooled rocket nozzle assembly. The braze process conditions, test results, metallurgical examination, conclusions and recommendations relative to the brazing of the first full-scale simulated NERVA nozzle section are described. (LCL)

29397 (TID/SNA-1378) SUMMARY TECHNICAL REPORT FOR NERVA REMOTE HANDLING SYSTEM. For the Period, 1 October 1963–30 September 1964. (AMF Atomics, York, Pa. (USA)). 1 Oct 1964. 49p. Dep. NTIS $5.50.

For Aerojet-General, Sacramento, CA.

Activities during the period from Oct. 1963 to Oct. 1964 in the design, procurement, fabrication, assembly and shop testing of components of the NERVA remote handling system are described. These components include the overhead positioning system, floor-mounted handling system, engine installation vehicle, and manned control car. The quality assurance program and training program for operating and maintenance personnel are discussed. (LCL)

29398 (TID/SNA-1383) RESULTS OF THE BRAZE DEVELOPMENT PROGRAM FOR THE NERVA REGENERATIVELY-COOLED ROCKET NOZZLE, SIMULATED SECTION NO. 2. Greer, R. Y. (Marquardt Corp., Ogden, Utah (USA)). 31 Jan 1964. 19p. Dep. NTIS $4.00.

For Aerojet-General Corp., Sacramento, CA.

The Aerojet-General Corporation has contracted The Marquardt Corporation to fabricate and deliver one regeneratively-cooled rocket nozzle assembly. The braze process and assembly conditions, test results, metallurgical examination, and repair procedures relative to the brazing of full-scale simulated NERVA nozzle section, No. 2 are described. (LCL)

29399 (TID/SNA-1385) TRANSMITTAL OF FDET MEMORANDA FOR ETS-1 FEP-III, PHASE I AND IA. Maxon, B. S. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 30 Jan 1967. 135p. Dep. NTIS $9.75.

The results obtained during tests made to evaluate the performance of Engine Test Stand-1 (ETS-1) for the NERVA program are presented. The operating characteristics of the liquid hydrogen cooldown system and the LH_2 flow control systems are emphasized. (LCL)

29400 (TID/SNA-1548) E-MAD EQUIPMENT STANDARDS HANDBOOK. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Mar 1966. 229p. Dep. NTIS $14.50.

Layout drawings and photographs of the NERVA Engine Maintenance and Disassembly Facility (E-MAD), assembly drawings and tabulated design characteristics of major facility equipment, and the design of special remote handling equipment, tools, jigs, and fixtures are presented in this handbook of E-MAD equipment standards. (LCL)

29401 (TID/SNM-10) FDET REPORT: ETS-1 FEP III-2. Booty, W. F. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 31 Mar 1967. 116p. Dep. NTIS $9.00.

Tests run on components of the liquid hydrogen system at the NERVA engine test facility are described and the results are presented. Also, heat damage to the test stand and adjacent areas caused by the exhaust plume from the temporary stack was evaluated. (LCL)

29402 (TID/SNW-15) ETS-1 ENGINE COMPARTMENT RADIATION SHIELDS. End Item Report. (Westinghouse Electric Corp., Sunnyvale, Calif. (USA). Marine Div.). [1966]. 395p. Dep. NTIS $22.75.

The tests, measurements, adjustments, inspections, and operations which must be accomplished in order to demonstrate that the ETS-1 radiation shields manufactured by the Marine Division of the Westinghouse Electric Corporation are acceptable to the Government are defined. (auth)

29403 (WANL-TME-220) FLOW REQUIREMENTS IN POST-OPERATIVE CELLS FOR THE E-MAD FACILITY. Svasek, A. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Dec 1962. 2p. Dep. NTIS $4.00.

A program for material flow in the post-operative cells of the Engine Maintenance, Assembly and Disassembly Facility (E-MAD) for the NERVA program is presented. (LCL)

29404 (WANL-TME-222) NRDS GENERAL SUPPORT FACILITIES. Wood, T. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Dec 1962. 6p. Dep. NTIS $4.00.

The requirements for general support facilities at NRDS are discussed. These facilities include machine and metal fabrication shops; electrical and electronic shops; standards laboratory; administration building; engineering building with its associated laboratories; health physics building, and warehouse and storage areas. (LCL)

29405 (WANL-TME-242) E-MAD FACILITY. Penetrations of South Wall of Hot Cells. Svasek, A. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Jan 1963. 2p. Dep. NTIS $4.00.

The design of hot cells for the Engine Maintenance, Assembly and Disassembly Facility for the NERVA program using one wall with removable sections is discussed. (LCL)

29406 (WANL-TME-266) COMMENTS ON E-MAD PHASE II DRAWINGS RECEIVED JANUARY 30, 1963. Svasek, A. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Feb 1963. 7p. Dep. NTIS $4.00.

Comments are presented on the design of the Engine Maintenance, Assembly and Disassembly facility for the NERVA program. (LCL)

29407 (WANL-TME-458(Vol.1)) DEMONSTRATION SHIPMENT OF A SIMULATED REACTOR BY RAIL. Volume I. McAllister, R. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 27p. Dep. NTIS $4.50.

An instrumented NRX shipping container loaded with a weight simulated NRX reactor was transported June 28 to July 6, 1963, from Large, Pennsylvania, to Las Vegas, Nevada, by special train, continuing on by tractor-trailer to the Maintenance Assembly and Disassembly (MAD) Building at the Nuclear Rocket Development Station (NRDS), Nevada. The container and reactor were returned to Large using the same procedures and routes. The shipment was conducted to demonstrate the ability of the container to provide adequate protection for the reactor during handling and transportation. The data obtained showed that the accelerations encountered were a small fraction of those for which the reactor was designed. (auth)

29408 (WANL-TME-461) PRELIMINARY ANALYSIS OF A SPRING-MASS SYSTEM WITH FLOW PARALLEL TO THE AXIS. Maguire, A. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Aug 1963. 35p. Dep. NTIS $4.75.

A spring-mass system consisting of a rigid beam of square cross-section between two springs of constant k with gas flow along both sides was analyzed parametrically on the analog computer. Some of the parameters varied were spring constant k, mass m, gap thickness T, member thickness t, and length l. The dependent variables were displacement x and pressures P_1 and P_2. The system behaves as a spring-mass combination influenced by the damping effect of fluid pressure. The frequency of oscillation was determined by the natural frequency of the combination and the amount of damping was dependent upon the values of parameters affecting the degree of pressure variation. An increase in the mass reduced the effect of a given pressure variation and also caused less damping. No attempt was made to study the effect of pressure levels in the analysis of this linearized model and hence more effort is needed to expand these preliminary results. (auth)

29409 (WANL-TME-1203) STATUS REPORT ON THERMAL STRESS ANALYSIS. Siriano, A. M.; Swanson, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1965. 11p. Dep. NTIS $4.00.

The application of the computer code, NBC, for calculation of stresses and strains resulting from radiation-induced dimensional changes in bodies such as those used in nuclear reactors is discussed. (TFD)

29410 (WANL-TME-1514) ETS-1 SOURCE DRIVE SYSTEM OPERATIONS AND MAINTENANCE MANUAL. Gormley, O. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 May 1967. 48p. Dep. NTIS $5.50.

Information for the installation, operation and maintenance of the ETS-1 Source Drive is presented. The function of the source drive is to provide a movable source of real neutrons which can then be used for an end-to-end checkout of the log range nuclear instruments. As designed, it allows checkout of all three ranges, both instruments and connections. (auth)

29411 (WANL-TME-2789) STRESS INTENSITY FACTORS FOR HEXAGONAL FRACTURE TOUGHNESS SPECIMENS. DeSalvo, G. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1971. 29p. Dep. NTIS $4.50.

Stress intensity factors are obtained for a hexagonal specimen containing a central hole and two diametrically opposed cracks originating from the inner surface. The specimen is loaded in compression along the hexagonal flat faces in a direction parallel to the plane of the cracks. Two different crack lengths are investigated for a uniform pressure loading. The effect of a uniform displacement loading on the stress distribution and the fracture load is discussed. The stress intensity factors are estimated by comparing the finite element displacements and stresses around the crack tip with the classical crack tip displacement and stress fields. In addition, estimates are made using the strain energy release rate method for comparison. (auth)

29412 ABSOLUTE KILOVOLTAGE CALIBRATION OF A DIAGNOSTIC X—RAY GENERATOR. Rauch, P.L.; Chaney, E.L.; Carson, P.L.; Hendee, W.R. (University of Colorado Medical Center, Denver, Colorado 80220). Med. Phys. 2: No. 1, 1-4 (Jan 1975).

A method for absolute calibration of diagnostic x-ray generators is presented and discussed. The method employs a Ge(Li) detector and relies on the direct observation of the onset of fluorescence radiation from scattering foils placed in the primary beam. (auth)

29413 EFFECT OF SOME NUCLEAR FUEL ROD PARAMETERS ON MECHANICAL DECLADDING BY ROLLER STRAIGHTENER TECHNIQUE. Hammad, F. H.; Higgy, H. R. (Atomic Energy Establishment, Cairo). Ann. Nucl. Sci. Eng.; 1: No. 9/10, 517-518(Sep 1974).

The feasibility was investigated of decladding simulated cylindrical fuel rods by the roller strengthening technique, to determine experimentally the effect of various fuel rod parameters on radial deformation. Test pieces were simulated fuel rods manufactured from various mandril materials and clad with different materials. The effects on radial deformation of outer radius of clad, clad thickness, yield stress of clad material and fuel material, were studied. The resulting experimental equations were compared with theoretical ones, and showed close agreement. (UK)

29414 DRAW-OFF VALVE. Dewulf, R.; Jaouen, A.; Rouyer, H. (to CEA, 75 - Paris (France)). French Patent 2,204,279/D/. 20 Oct 1972. 7p. (In French).

Description is made of a draw-off valve comprising an elongated hollow body open at one end thereof communicating with an enclosure containing a liquid to be drawn off, and closed by a sealing gasket at the opposite end thereof located out of the enclosure. The valve is characterized in that it comprises a flap of conical shape adapted to co-operate with a seat provided at the body open end, a hollow rod being mounted along the body axis and passing through the flap and through the gasket, said rod being provided, outside the body with a transverse backing flange for a spring mounted between said flange and the body and adapted to exert a permanent stress for applying the flap against its seat, and a draw-off tube for drawing off the liquid. That valve can be used for drawing off an emulsion in a liquid-liquid extraction pulsed column. (FR)

29415 DEVICE FOR MELTING AND MOULDING REFRACTORY MATERIALS AT TEMPERATURES UP TO 2500 DEG C. Lungu, S.; Dragomir, I.; Beleuta, I. L. (Institutul de Fizica Atomica, Bucharest (Romania)). Rev. Int. Hautes Temp. Refract.; 11: No. 3, 177-181(Jul 1974).

A melting and moulding device for refractory materials (up to 2500 deg°C) is described. It is used for obtaining vitroceramic nuclear fuel elements. The useful melting volume is about 4000 cm^3. The electric resistances are made of refractory strips and the furnace design allows hot chambers of any size to be obtained. The melted material is injected into the casting mold by a variation of pressure in the furnace and the fusible part of the mold is released by overturning the casted piece. The melting and molding device can operate both in inert and reducing atmosphere. (FR)

29416 A DEVICE FOR THE REMOTE CONTROL AND MEASUREMENT OF THE STRAINS OF A SAMPLE TEST PIECE SUBMITTED TO STRESSES IN AN AGGRESSIVE MEDIUM. Le Bot, C. (Societe d'Etudes Technologiques Peeters, 92 - Chatenay-Malabry (France)); Thomas de Montreville, C. (CEA, 75 - Paris (France)). (to CEA, 75 - Paris (France)). French Patent 2,187,117/D/. 31 May 1972. 14p. (In French).

This device is characterized in that it comprises a capsule with means for exerting a stress on the test piece through a con-

tact member provided with an extension which is restrained from rotating and is outwardly helically threaded, a freely rotating feeler-nut restrained from moving along a reference test-piece and adapted to cooperate with said helical thread, this nut being imparted to and fro rotation under the action of a remote control means, and means for locating and directly reading the nut rotation. The device can be applied to creep measurements in a test piece submitted to intense radiations, e.g. to a heavy neutron flux. (FR)

29417 A DEVICE FOR AN EVAPORATION OF LIQUIDS WITHOUT SEPARATION FOR ANALYSIS SAMPLES. Thurston, W. M. (to Atomic Energy of Canada Ltd., Ottawa, Ontario). German(FRG) Patent 2,009,961/C/. 19 Apr 1973. 5p. (In German).

The patent describes a device which allows the evaporation of liquids without separation for the production of representative analysis samples. It consists of a tube tapering to a capillary and dipping into the liquid to be analyzed, whereas the other side of the tube is connected to the analyzer, e.g., a mass spectrometer over a vacuum source. The tube is movable relative to the container with the liquid to be analyzed, and a valve which is controllable from outside can disconnect the vacuum source from the analyzer or the tube, respectively, as required. (GE)

29418 TELEVISION DEVICE FOR OBSERVATION OF A WELDING BATH. Vaugoyeau, H.; Schickel, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Service de Developpement et d'Essais d'Elements Combustibles). Metaux (Corros.-Ind.); 49: No. 587, 295-298 (Jul 1974). (In French).

From meeting on welding metallurgy; Marseille, France (8 Nov 1973).

The special conditions required for the welding of plugs on Pu fuel pins of fast neutron reactors have led to the development of a remote control observation process by television. This involves an original optical device based on the use of two converging optical systems: one with a long focal length giving little enlargement, the other with a short focal length to give a macrophotographic image. (FR)

29419 TEST RESULTS ON THE TENDONS FOR A PRESTRESSED CONCRETE PRESSURE VESSEL LEFT ALONE FOR ONE YEAR IN TENSION. Hisatomi, Y. (Shimizu Construction Co. Ltd., Tokyo (Japan). Research Lab.); Sakai, H.; Tomioka, H. Puresutoresuto Konkurito.; 16: No. 1, 10-17(Feb 1974). (In Japanese).

The tendons having the same length and angular change as the standard tendons installed in a Hinkley-Point B type prestressed concrete reactor vessel were manufactured, and four tendons were installed around a circular arc concrete block. During the installing work, the frictional characteristics of tendons and the working conditions of prestressing process were investigated. After those investigations, four tendons were installed in the circular concrete block, fixed in tension, and left alone from Aug. 25, 1971 to Sept. 15, 1972. The tension of the tendons decreased about 7.2% on fixed side and 7.5% on strained side. Stabilized prestressing steel was utilized, so that the decrease of tension was smaller than that of traditional one. The surface of the prestressing steel tendons was completely covered with grease (Shell Alvania EP1). The viscosity of grease decreased a little, but the surface of tendons did not rust at all. Therefore it was found that the corrosion-protective property of this grease was perfect. It was found that the released tendons have a little smaller relaxation value than unused one. From the data one year after prestressing, the relaxation value of these tendons at 60°C after 30 y was estimated to be 5.56% by Larson-Miller parameter method. (JA)

Lasers

Refer also to abstract 29312.

29420 (AD-786745) PLASMA CATHODE FOR E-BEAM LASERS. Semiannual Technical Report, 1 January 1974 - 30 June 1974. Bayless, J. R. (Hughes Research Labs., Malibu, Calif. (USA)). Sep 1974. 53p. NTIS $4.25.

The objective of this program is to develop the plasma cathode electron gun and to demonstrate that it has properties which make it suitable for application to E-beam lasers. The source of electrons in this new and advanced electron device is a plasma generated within a low-voltage hollow-cathode discharge; a thermionic emitter is not required. Electrons extracted from the plasma pass through a triode-type control grid structure and are accelerated to high energies in a plasma-free region prior to emerging from the gun through a thin foil window. The device, which is capable of both pulsed and cw operation, is characterized by durability, low cost, low power consumption, minimal pumping requirements, small size, and fast turn-on in comparison to thermionic E-guns. (auth)

29421 (AD-787716) INTERACTION BETWEEN UNSTABLE OPTICAL RESONATOR AND CW CHEMICAL LASER. Mirels, H. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Sep 1974. 40p. (SAMSO-TR-74-209). NTIS $3.75.

The interaction between an unstable resonator and a cw diffusion-type chemical laser with turbulent or laminar mixing is analyzed by means of geometric optics and a simplified chemical model. Both cylindrical and spherical optics are considered. The radiation is assumed to be diverging, i.e., converging radiation is neglected, and the gain region is assumed adjacent to one of the resonator mirrors. Laser performance is found to depend on the magnification, the ratio of pumping to collisional deactivation rate, the normalized diffusion distance, the normalized axial location of resonator axis, the normalized axial length of resonator, the mirror absorptivity, and the net zero power gain. Analytic solutions are obtained for the limiting cases (M - 1) Mach < and 1/M Mach <. In the former case, the laser medium is almost completely saturated, and resonator efficiency is high. In the latter case, the radiation incident on the gain region originates near the optical axis and is uniform. (GRA)

29422 (AD-787895) HIGH ENERGY PULSED LIQUID LASER. Final Technical Report, 1 July 1967 - 31 March 1974. Samelson, H.; Kocher, R. (GTE Labs., Inc., Waltham, Mass. (USA)). 30 Aug 1974. Contract N00014-68-C-0110. 430p. NTIS $11.25.

The objectives of the project were to evaluate inorganic liquid laser materials in high average power and high brightness applications. The reported work extends from research on the laser materials to system design and construction. This report is divided into the following technical sections: the chemistry and properties of liquid laser materials; liquid laser systems, including static and circulatory systems and system, subsystem and component design; the hydrodynamic and thermo-optical properties of liquid lasers; and laser and amplifier behavior (static and circulatory), including high average and power performance, self Q-switching, mode locking, and the limitations of inorganic liquid systems in terms of nonlinearities and optical quality. (auth)

29423 (AD/A-000382) $In_xGa_{1-x}As$ 1.06-MICROMETER INJECTION LASERS. Final Report, 15 March 1973 - 14 March 1974. Nuese, C. J.; Ettenberg, M. (RCA Labs., Princeton, N. J. (USA)). Aug 1974. Contract F33615-73-C-1177. 71p. (PRRL-74-CR-26). NTIS $4.25.

Electroluminescent junctions of $In_xGa_{1-x}As$ for 1.06-micrometer laser diode evaluation have been prepared by vapor-phase and liquid-phase epitaxial growth techniques. Their performance is reported. A comparison of $In_xGa_{1-x}As$ epitaxial layers ($0 < X < 0.25$) prepared by LPE and VPE has shown that the liquid-phase material has significantly higher dislocation densities than the vapor-grown layers. Dislocation densities, minority-carrier diffusion lengths, and electroluminescence efficiencies are discussed. The operating life of the $In_xGa_{1-x}As$ P-N junctions has been found to be significantly higher than that of comparably prepared GaAs junctions. The improved resistance to gradual degradation with increasing InAs content is tentatively attributed to reduced junction emission energy and to the existence of a "phonon-Kick" degradation model. (auth)

29424 (AD/A-000503) HIGH CW OUTPUT POWER IN STRIPE-GEOMETRY PBS DIODE LASERS. Ralston, R. W.; Calawa, A. R.; McVittie, J. P.; Walpole, J. N.; Harman, T. C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 19 Sep 1975. 5p. (JA-4289; ESD-TR-74-205). J. Appl. Phys.; 45: No. 3, 1323-1325(Mar 1974).

Stripe-geometry PBS diode lasers have been developed with cw output powers of about ½ W in the 4.3 micrometer wavelength region. A maximum cw output power in a single longitudinal mode of about 50 mW, over-all external quantum efficiencies as high as 27%, and incremental internal quantum efficiencies near 60% have been observed. The improved performance has been achieved through a number of significant developments in device technology. (auth)

29425 (IPP-4-67) PRESSURE BROADENING OF THE 1.3 μm IODINE LASER LINE. Fuss, W.; Hohla, K. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Dec 1974. 37p. (In German). Dep. NTIS (US Sales only) $5.00.

Storable energy of a high energy laser is inversely proportional to its stimulated emission cross-section σ. By adding a foreign gas, the emission line is broadened and σ is thereby lowered. We have measured σ of the iodine laser as a function of pressure of several gases (Ar, N_2, CO, CO_2, SF_6, CF_3Br, C_3F_7J, CF_2Cl_2, $(CF_3)_2$ CO) by an absolute and a relative method. $1/\sigma$ is a linear function of pressure in spite of the fact that overlapping of the hyperfine structure components varies considerably in the range investigated.

For energy storage, CO_2 is a good compromise between pressure broadening and chemical deactivation of the excited I atoms. At one atmosphere of CO_2, 5 to 7 J cm^{-2} can be stored, hyperfine structure is extensively blurred, and amplification of pulses shorter than 100 psec should be possible. (auth)

29426 (LA-5892-MS) ($\nu_1-2\nu_2$) FERMI RESONANCE LEVELS IN CO_2. Judd, O. P. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1975. Contract W-7405-ENG-36. 4p. Dep. NTIS $4.00.

The spectroscopic assignments, level character, and absolute energy of the $\nu_1-2\nu_2$ Fermi-coupled levels in CO_2 are considered. A critical review of rates for the exchange of vibrational energy within these levels by collisions has been carried out. (auth)

29427 (LA-UR-75-286) REVIEW OF SOFT X-RAY LASERS USING CHARGE EXCHANGE. Cantrell, C. D.; Scully, M. O.; Boyer, K. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 101p. (CONF-750110-2). Dep. NTIS $8.25.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

A review of charge exchange vacuum ultraviolet and soft x-ray lasers using ion beams is presented. The basic idea of the reaction is that one avoids the rapid Auger rates characteristic of many other x-ray laser schemes by picking up an electron in the outer shell of a hydrogen-like, helium-like, or lithium-like ion. The cross section for pickup in an excited state is larger than for pickup in the lower state for some range of ion energies, due to a near resonance between the state into which pickup occurs and the state of an appropriate target atom. One of the major new results presented is a discussion of a coherent calculation of the gain to be expected in swept excitation. It is shown that simple estimates of the gain based on rate equations may seriously misrepresent the actual behavior of a system subjected to traveling-wave excitation. The finite time required for the atomic population to generate a coherent dipole moment, reduces the maximum value of the gain below the rate equation value. Dicke superradiance increases the energy obtained from the laser, but only after a substantial distance. Taking full account of the effect of laser lethargy and superradiance, a complete, correct gain equation for such lasers is derived. Numerical estimates of the gain to be expected in the situations of concern are given. The physical realizability of systems with the parameters which are required according to the gain equation is discussed. In particular, it is shown that gas jet targets with the appropriate density and sharpness can be constructed. The experimental charge-exchange cross sections, and the Doppler width to be expected as the result of the interaction between the ion beam and the target is discussed. The production of ion beams of the appropriate current and focused to the required spot size, taking into account the effects of space charge and emittance is discussed. Finally, it is shown that the required focus and deflection can be achieved with a simple system. It is concluded that it is possible, using current technology, to achieve a soft x-ray laser at a wavelength of 304Å with a small signal gain of over 100, using a duoplasmatron ion source, or a gain of 10^4, using a plasma-gun source. (TFD)

29428 (UCRL-76619) TEST FOR LASER DISCS. Glassman, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Mar 1975. 17p. (CONF-750311-2). Dep. NTIS $4.00.

From workshop on optical fabrication and testing; San Mateo, California, USA (12 Mar 1975).

Tests used by the Lawrence Livermore Laboratory and its vendors for laser discs will be discussed giving special emphasis to test aspects which are unique or more difficult for discs. The tests are divided into those for dimensional and optical properties. Some unusual aspects of laser disc testing include high precision of refractive index homogeneity and edge profile which can be measured using special gages or coordinate measuring machines. Analysis of data and the precision of the measurement will be discussed. Some alternate methods of test are included. (auth)

29429 EFFICIENT MODULATION AND COUPLING OF CW JUNCTION LASER LIGHT USING ELECTROOPTIC WAVEGUIDES. Hammer, J. M.; Kressel, H.; Ladany, I.; Nell, C. C.; Phillips, W. (RCA Labs., Princeton, NJ). Proc. IEEE (Inst. Elec. Electron. Eng.); 63: No. 2, 325-326(Feb 1975).

The use of an electrooptical-waveguide modulator to achieve over 80% modulation of 7980-Å light from a room temperature laser diode operating at 10 mW CW is reported. The insertion loss of the modulator including couplers is 8.5 dB, and the output beam has high coherence. (auth)

29430 COUPLING COEFFICIENTS AND PROPAGATION CONSTANTS IN GUIDED WAVE DISTRIBUTED-FEEDBACK LASERS. Streifer, W.; Burnham, R. D.; Scifres, D. R. (Xerox Palo Alto Research Center, CA). J. Appl. Phys.; 46: No. 2, 946-948(Feb 1975).

Coupling coefficients and propagation constants in guided-wave distributed-feedback lasers are calculated. It is shown that higher-order transverse modes often have substantially larger coupling coefficients than do low-order transverse modes. Thus, higher-order modes require lower net gains at threshold. Grating spacings which resonate these higher-order modes are calculated and shown to differ significantly from the values appropriate to low-order modes. Higher-order modes also resonate at greater frequency separations, thus facilitating single-mode operation. (auth)

29431 THERMAL RESISTANCE OF HETEROSTRUCTURE LASERS. Joyce, W. B.; Dixon, R. W. (Bell Labs., Murray Hill, NJ). J. Appl. Phys.; 46: No. 2, 855-862(Feb 1975).

A GaAs-GaAlAs heterostructure laser is modeled as a stripe heat source embedded in a layered structure, and an analytic expression is given for the steady-state thermal resistance $\langle R \rangle$ of the model. Over the range of typical layer thicknesses and conductivities, and for heat generated uniformly in the active region, $\langle R \rangle$ varies between 14 and 31 K/W for a 12×375-μ active region. Four types of heat sinks are shown to contribute an additional 3 to 10 K/W. Design implications are drawn for various properties including layer thicknesses, heat-sink and bond parameters, and radiative heat transfer by spontaneous emission. In disagreement with the common tacit assumption of a unique active-region temperature, it is found that about 40% of the temperature drop within the laser occurs in the active region (center to edge). (auth)

29432 THIN-FILM RING DISTRIBUTED-FEEDBACK LASER. Tsang, W. T.; Wang, S. (Univ. of California, Berkeley). J. Appl. Phys.; 46: No. 2, 838-841(Feb 1975).

We report the construction and operation of a ring distributed-feedback laser formed by incorporating a periodic structure as part of the plain ring laser. The characteristics of the observed spectrum are in general agreement with theoretical analysis. Mode selection and bandwidth narrowing have been observed. (auth)

29433 60-J 1-nsec IODINE LASER. Hohla, K.; Brederlow, G.; Fuss, W.; Kompa, K. L.; Raeder, J.; Volk, R.; Witkowski, S.; Witte, K. J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger). J. Appl. Phys.; 46: No. 2, 808-809(Feb 1975).

A systems description is given for a two-stage oscillator-amplifier iodine laser setup. Detailed technical data are reported and information is given on the pressure dependence of the oscillator pulse, the gas composition for the oscillator and amplifiers, the small-signal amplification, and the energy storage and energy extraction in the amplifier stages. These performance data demonstrate the suitability of this new laser system for high-energy short-pulse operation. (auth)

29434 CHARACTERISTICS OF AN ARGON-LASER-PUMPED RUBY LASER. Szabo, A. (National Research Council of Canada, Ottawa). J. Appl. Phys.; 46: No. 2, 802-807(Feb 1975).

The characteristics of a quasi-cw single-mode ruby laser which is pumped by an argon laser are described. Particular emphasis is given to aspects which govern the linewidth. By heterodyning two independent lasers, linewidths as narrow as 0.5 MHz have been observed, averaged over a few seconds. (auth)

29435 POROUS-WALL BeO CAPILLARY WAVEGUIDE LASER. Papayoanou, A.; Fujisawa, A. (Army Electronics Command, Fort Monmouth, NJ). Appl. Phys. Lett.; 26: No. 4, 158-160(15 Feb 1975).

Small-bore capillary tubes exhibit very high optical gains and saturation intensities in flowing gas CO_2 systems. However, these parameters may vary greatly in the axial direction due to the nonuniform axial pressure distribution. Use of porous-wall BeO capillary tubes makes it possible to attain a more uniform pressure distribution and to usefully scale capillary waveguide amplifiers to longer lengths. (auth)

29436 NONCHEMICAL HF PULSE LASER PUMPED BY e-BEAM-SUSTAINED DISCHARGE. Osgood, R. M. Jr.; Mooney, D. L. (Massachusetts Inst. of Tech., Lexington). Appl. Phys. Lett.; 26: No. 4, 201-204(15 Feb 1975).

Experiments with a pulsed discharge-pumped (nonchemical) HF laser are described. The laser discharge is sustained with a cold cathode electron beam gun. An output power of 8 kW/cm^2 in a 2.5-μsec pulse length is obtained. Several observations regarding the laser mechanism are made. (auth)

29437 NATURE OF HIGH-FREQUENCY PULSATIONS OF EMISSION OF A LASER WITH TRANSLUCENT FILTER. Samson, A. M.; Kotomtseva, L. A.; Milinkevich, A. V.; Shapovalyuk, N. K.

pp 346-349 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

A stability study is done on a system of nonstationary transport equations for a traveling-wave laser with consideration of the position of the active rod and translucent filter in the resonator cavity, and probabilistic equations for the populations of energy levels close to the steady-state value. A numerical solution is found on the Minsk-2 computer for parameters corresponding to a ruby laser with translucent filter. The completed investigation shows that the proposed method has promise for calculating emission of ultrashort pulses of lasers with passive Q-switching, and demonstrates that the formation of high-frequency pulsations is independent of the mode structure of the emission. (Referativnyi Zh.)

29438 SPECTRAL COMPOSITION OF SeII LASER EMISSION. Zinchenko, S. P.; Saprykin, E. G.; Chapovskii, P. L. pp 219-221 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation is made of the physical processes which occur during emission in a helium-selenium laser, and of its most important spectral characteristics. Data are presented on thinning of emission modes with a reduction in the excess of amplification over losses. The authors confirm the possibility of obtaining powerful single-frequency emission in a selenium laser by a previously suggested method, and the drift rate of SeII ions is calculated. At i = 500 mA, P = 4 mm Hg, drift was 130 m/s, and displacement was 40 MHz/mm Hg toward the blue region of the spectrum. (Referativnyi Zh.)

29439 THEORY OF SHORT-WAVELENGTH LASERS FROM RECOMBINING PLASMAS. Jones, W.W.; Ali, A.W. (Plasma Physics Division, Naval Research Laboratory, Washington, D.C. 20375). Appl. Phys. Lett. 26: No. 8, 450-451 (15 Apr 1975).

Starting with a plasma of fully stripped ions (arbitrary Z) with an initial temperature and electron density, the set of rate equations governing the population densities of all discrete levels of hydrogenlike ions are solved. The results (population inversion and gain) are presented for a variety of cases, hydrogen through carbon, with emphasis on short-wavelength lasers. (auth)

29440 A 3400-Å *p*-TERPHENYL DYE LASER PUMPED BY A CO_2-LASER-PRODUCED PLASMA. Silfvast, W.T.; Wood II, O.R. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Appl. Phys. Lett. 26: No. 8, 447-449 (15 Apr 1975).

Ultraviolet radiation from a xenon plasma produced with a high-pressure pulsed CO_2 laser has been used to pump a 3400-Å *p*-terphenyl dye laser. Potential advantages of laser-produced plasmas over electrical flashlamps as pumping sources for uv dye lasers are discussed. (auth)

29441 ENHANCED NONLINEAR OPTICAL EFFECTS IN ROTATIONALLY TWINNED CRYSTALS. Dewey, C.F. Jr.; Hocker, L.O. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Appl. Phys. Lett. 26: No. 8, 442-444 (15 Apr 1975).

We have produced continuously tunable infrared radiation between 4 and 21 μm by mixing the outputs of a ruby laser and a ruby-pumped dye laser in a single rotationally twinned ZnSe crystal. The peak output power of 5 W at 4 μm is approximately 250 times larger than the power obtained from an untwinned ZnSe crystal of comparable length. This enhancement is attributable to randomly spaced rotational twin planes perpendicular to the direction of propagation. Regularly spaced twins should produce an enhancement proportional to the square of the number of twin planes. (auth)

29442 A SIMPLE METHOD OF DETERMINATION OF ELECTRON DENSITY IN POSITIVE-COLUMN He-METAL LASER DISCHARGES. Mizeraczyk, J.K. (Institute of Fluid-Flow Machines, Polish Academy of Sciences, Gdańsk, Poland). J. Appl. Phys. 46: No. 4, 1847-1848 (Apr 1975).

A new simple method of determination of electron density in positive-column He-metal laser discharges using the double probe is presented. The results obtained are in good agreement with those measured with the microwave cavity technique by other investigators. (auth)

29443 RUNAWAY OF FAST ELECTRONS PENETRATING A THICK ABSORBER UNDER THE INFLUENCE OF AN ELECTRIC FIELD. Bowden, C.M.; Perkins, J.F.; Raiford, M.T.; Shatas, R.A. (U. S. Army Missile Command, Redstone Arsenal, Alabama 35809). J. Appl. Phys. 46: No. 4, 1824-1826 (Apr 1975).

In connection with electron-beam-preionized electrical-discharge-pumped gas lasers, we have performed Monte Carlo calculations of transport of fast electrons in an absorber subject to an externally applied electric field which tends to add energy to the fast electrons. It was found that when the magnitude of the field (in suitable units) substantially exceeds the stopping power of the absorber at the incident energy, an appreciable fraction of the fast electrons undergo a net increase of energy which can be quite large for thick absorbers. Results are presented for 0.1 MeV incident energy, an absorber thickness of 0.2 g cm^{-2}, and several values of electric field. For the larger values of applied field, the distribution of energies of emergent electrons tends to bunch toward the maximum possible energy. (auth)

29444 INVESTIGATIONS OF GLOW DISCHARGE FORMATION WITH VOLUME PREIONIZATION. Kline, L.E.; Denes, L.J. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Appl. Phys. 46: No. 4, 1567-1574 (Apr 1975).

The discharge formation process has been studied experimentally for CO_2 planar TEA laser discharges. Theoretical models are presented which predict the preionization electron and ion densities, the spatiotemporal development of the discharge plasma, discharge voltage, and current waveforms, and the quasisteady operating characteristics of the discharge. The preionization is provided in the experiments by a pulse of ultraviolet radiation. The discharge formation model accounts for cathode photoemission and anode collection of electrons, discharge-circuit interactions, and gaseous ionization processes. The model predicts that photoemission and anode collection can be neglected when strong preionization and moderate overvoltages are used. When photoemission and anode collection are neglected, the discharge formative time is independent of the discharge volume. Calculated and experimental voltage and current waveforms are in very good agreement. The results of the calculations show that the discharge formative time is determined primarily by the characteristics of the external circuit in the experiments. Formation calculations for a large-volume discharge show that a uniform glow discharge will develop even when the preionization is nonuniform along the electric field, and confirm that the formative time is approximately independent of the discharge volume. (auth)

29445 INVESTIGATION OF THE FREQUENCY CHARACTERISTICS OF A LASER WITH COMBINED ACTIVE MEDIUM. Belousov, N. D.; Skorobogatov, E. S. pp 62-66 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian)

An investigation is made of the spectral and kinetic characteristics of a laser with combined active medium based on the following active elements in different combinations: $CaWO_4:Nd^{3+}$ (optical axis of the crystal oriented 0° relative to the geometric axis of the element), λ_e = 1065.2 nm, $CaWO_4:Nd^{3+}$ (90°), λ_e = 1058.2 nm, $LaNa(WO_4):Nd^{3+}$ (0°), λ_e = 1063.7 nm and $Y_3Al_5O_{12}:Nd^{3+}$, λ_e = 1064.1 nm. To eliminate the influence of spatial nonhomogeneity of inverse population on the spectral makeup of emission, a cavity with variable optical length is used. It is concluded that stimulated emission of a combined active medium in the case of nonoverlapping emission spectra may be two-transition emission. Frequency tuning in this case is observed only with appreciable spectral nonhomogeneity. Simultaneous emission on two transitions after eliminating spatial nonhomogeneity also takes place in the case of spectral nonhomogeneity of one of the elements of the combined active medium. Final conclusions as to the mechanism of suppression of emission on one of the transitions can be apparently made after analogous studies of stationary and two-transition emission in spectrally homogeneous media. (Referativnyi Zh.)

29446 FOUR-PHOTON PARAMETRIC GENERATION INSIDE THE CAVITY OF A PUMPING LASER. Barantsov, V. I.; Popov, A. K.; Tartakovskii, G. Kh. pp 317-320 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian)

The possibilities of four-frequency parametric emission in gases were analyzed. One of the possibilities for surpassing the threshold of stimulation of parametric emission in gases in the continuous mode is to use resonance phenomena and to use a nonlinear medium in the cavity of a gas laser. However, the increase of nonlinear susceptibility is accompanied by an increase in linear absorption, and therefore in order to minimize the emission stimulation threshold, additional optimization of the parameters of the medium and off-resonance tuning are necessary. (Referativnyi Zh.)

29447 MECHANISMS OF INTERACTION OF THE 4880 AND 5145 A LINES IN AN ARGON CONTINUOUS EMISSION LASER. Grimblatov, V. M.; Ostapchenko, E. P.; Teselkin, V. V. pp 264-266 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian)

Results of studies of the frequency spectrum in the region of anomalous interaction of the transitions $4p^4\ D_{5/2}^0 \rightarrow 4s^4\ P_{5/2}$ (λ = 5145 Å) and $4P^2\ D_{5/2} \rightarrow 4S^2\ P_{5/2}$ (λ = 4880 Å) in a continuous-emission argon laser are presented. The observed influence of frequency tuning in the emission channels on the form of interaction is attributed to the presence of a region of anomalous competition of the 4880 and 5145 Å emission lines. The anomalous interaction of transitions is explained, apparently, by the simultaneous influence of mode competition and competition as a consequence of the common level. With increasing distance

from the threshold there is an increase in the number of troughs in the contours of amplification of interacting transitions. Overlap leads to losses in the channel on practically all frequencies, resulting in transition to normal interaction. (Referativnyi Zh.)

29448 QUASICONTINUOUS PARAMETRIC LIGHT EMITTER WITH PUMPING BY THE SECOND HARMONIC OF A NEODYMIUM-ACTIVATED YAG LASER. Dmitriyev, V. G.; Kovrigin, A. I.; Kholodnykh, A. I. pp 212-216 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian)

Results of a study of parametric light emitters with pumping by the second harmonic of the LTI-5 Soviet commercial laser, operating in the Q-switching mode with pulse recurrence rate of up to 100 Hz are presented. The crystals for the parametric light emitter were lithium niobate and α-iodic acid. The stereostructure of the parametric light emitter was studied by an electronic optical converter, and the spectral characteristics were studied by a spectrograph; in the latter case the emission of the device was converted to the visible band by frequency doubling in a special lithium niobate crystal. It is noted that further improvement of the investigated lasers is primarily a matter of developing more stable and wider-band dielectric coatings, using higher quality nonlinear crystals, with better matching of the pumping pulse duration with the time for establishment of steady-state oscillations in the parametric light emitter, and also utilizing frequency spectra. (Referativnyi Zh.)

29449 TUNING THE EMISSION FREQUENCY OF THE SECOND HARMONIC OF A NEODYMIUM LASER IN CRYSTALS OF LITHIUM IODATE AND α-IODIC ACID. Volosov, V. D. pp 196-198 of Lazery s Perestraivayemoy Chastotoy. Kiev.; Naukova Dumka (1973). (In Russian)

An investigation was made of frequency tuning of the emission of the second harmonic of a neodymium laser in crystals of lithium iodate and α-iodic acid. It is shown by the estimates obtained that the frequency spectrum of emission of the second harmonic stimulated in these crystals by emission of a neodymium laser with a broad spectrum of several dozen Å is considerably narrower than the width of the spectrum of the simulating emission. It is noted that the observed continuous tuning of the emission on the harmonic with appreciable (more than an order) narrowing of the spectrum as compared with the stimulating emission can be utilized for resonant action of radiation on matter. (Referativnyi Zh.)

29450 PARTICULARS OF EMISSION OF ORGANIC DYES AND HARMONICS OF SOLID STATE LASERS IN DISPERSION CAVITIES. Kravchenko, V. I.; Smirnov, A. A.; Soskin, M. S. pp 192-196 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian)

An investigation is made of intracavity generation of emission harmonics of a monopulse laser on neodymium glass with prism dispersion cavity. In addition to the high coefficient of conversion of solid state laser emission to harmonic radiation, an advantage of the proposed scheme is the feasibility of continuous tuning of the fundamental frequency, and accordingly also its harmonics. Continuous tuning of emission wavelength is achieved in the ranges: 10,500 to 10,900 Å (fundamental frequency), 5250 to 5450 Å (second harmonic), 2500 to 3650 Å (third harmonic). (5 references) (Referativnyi Zh.)

29451 SINGLE-FREQUENCY RUBY MONOPULSE LASER. Morgun, Yu. F.; Muravitskii, M. A. pp 71-74 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian)

The feasibility of obtaining giant pulses on a ruby laser with minimum spectral width was studied. High-resolution interferometric equipment was used. The narrowest emission spectrum was observed when an unstable cavity was used containing a resonant reflector, iris and cell with translucent liquid (gallium chloride phthalocyanin in chlorobenzene). With initial cell transmission (T_0) of 83%, the laser produced single-frequency emission with spectral width of 14.8 MHz. The energy of the emitted pulse can be increased by using an amplifier with retention of spectral composition. Apparently with further improvement of methods of mode selection and increase in resolution of recording equipment giant pulses can be achieved with a still narrower spectral makeup. (Referativnyi Zh.)

29452 PROPOSED DISTRIBUTED FEEDBACK CRYSTAL CAVITIES FOR X-RAY LASERS. Elachi, C.; Evans, G.; Grunthaner, F. (California Inst. of Tech., Pasadena). Appl. Opt.; 14: No. 1, 14.15(Jan 1975).

A laser cavity using zeolite crystals that would guide the emitted x rays and at the same time generate the necessary feedback for self-sustained oscillation is proposed. (TFD)

29453 FLASHLIGHT-SIZE EXTERNAL CAVITY SEMICONDUCTOR LASER WITH NARROW-LINEWIDTH TUNABLE OUTPUT. Heckscher, H.; Rossi, J. A. (Massachusetts Inst. of Tech., Lexington). Appl. Opt.; 14: No. 1, 94-96(Jan 1975).

The construction of a compact and relatively inexpensive external cavity to be used with III-V compound semiconductor injection lasers is described. The operation of a typical GaAs diode in the cavity and some of the limiting performance factors are discussed. (auth)

29454 EXTENSION OF $3p \rightarrow 3s$ ION LASERS INTO THE VACUUM ULTRAVIOLET REGION. Elton, R. C. (Naval Research Lab., Washington, DC). Appl. Opt.; 14: No. 1, 97-101 (Jan 1975).

The feasibility of extending existing near-ultraviolet ion lasers into the vacuum ultraviolet spectral region is analyzed with a simplified three-state model. Single-pass amplification in a laser-produced plasma of reasonable length, pump power, and rise-time requirements is predicted, especially for high electron temperatures. The results are intended to serve as a basis and incentive for detailed numerical modeling and for experiments. (auth)

29455 SPATIAL COHERENCE OF EMISSION OF A QUASICONTINUOUS YAG LASER WITH NARROW SPECTRAL LINE. Arutyunyan, A. G.; Golyayev, Yu. D.; Tunkin, V. G.; Chirkin, A. S. pp 51-54 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

The results of an investigation of the spatial coherence of emission of a YAG:Nd laser which operates in the quasicontinuous mode are reported. In order to achieve satisfactory spatial resolution as the spatial coherence of the emission changes, a polarization interferometer was used. This enabled a precision measurement of the small correlation radius of the YAG laser. As a test, the spatial correlation function of the TEM_{00} mode of the LG-55 continuous laser ($\lambda = 0.63\ \mu m$) was measured. (Referativnyi Zh.)

29456 FINE STRUCTURE OF THE EMISSION SPECTRUM OF A NEODYMIUM GLASS TRAVELING WAVE LASER. Kravchenko, V. I.; Tarabrov, V. V.; Manuil'skii, A. D. pp 44-48 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

Results of studies of the emission spectra of neodymium glasses under conditions of controllable uniformity of population inversion of the active medium are reported. It was found that a traveling wave laser on neodymium glass can emit on a single stable frequency and can have both a high spectral brightness of emission and the possibility for continuous frequency tuning within the limits of the luminescence spectrum of the active medium. (Referativnyi Zh.)

29457 TUNING THE EMISSION FREQUENCY OF LASERS ON PHTHALIMIDE SOLUTIONS. Das'ko, A. D.; Pikulik, L. G. pp 140-145 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of various modifications of tuning the emission frequency of lasers on phthalimide solutions, i.e., by altering the solvent; by changing the temperature of the working solution; and by investigation of binary mixtures of solvents. In the first instance the emission spectra can be shifted only within certain spectral ranges, but despite this the maximum tuning range is 3800 cm^{-1}. The second method is relatively simple since it does not require changing the cells with solution during operation, and the shift in this case is ~2500 cm^{-1}. It was found that especially large displacements of the emission band (>3500 cm^{-1}) can be achieved by using binary mixtures of solvents with the temperature method of tuning. (Referativnyi Zh.)

29458 PECULIARITIES OF EMISSION OF SOLID STATE LASERS WITH UNSTABLE CAVITY. Lopasov, V. P.; Makogon, M. M.; Ponomarev, Yu. N.; Serdyukov, V. I. pp 94-96 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of a ruby laser with unstable cavity and a crystal with the ends cut off at the Brewster angle. The emission spectrum, threshold pumping energy, emission output power and its time characteristics are measured as functions of cavity length. The laser threshold curve shows two steps 2 to 3 cm wide and spaced 3 to 4 cm apart. A similar effect observed previously for neodymium glass lasers with an analogous cavity can apparently be attributed to the influence of astigmatism created by an active element with ends cut at the Brewster angle. (Referativnyi Zh.)

29459 SYNCHRONIZATION OF TWO SOLID-STATE LASERS UNDER CONDITIONS OF NONSTATIONARY EMISSION. Golubeva, N. S.; Kozintsev, V. I.; Rozhdestvin, V. N.; Lebedenko, V. P. Izv. Vyssh. Ucheb. Zaved., Radioelektron.; 17: No. 9, 25-30(Sep 1974). (In Russian).

An examination is made of questions of synchronizing two coupled solid-state lasers. The behavior of the system under conditions of nonstationary emission is investigated on the basis of quasiclassical laser theory. A numerical analysis is done on a computer to determine the speed of synchronization over a wide range of variation in mismatch of the lasers, coupling coefficients, gain and losses. (JPRS)

29460 SOLID STATE LASERS WITH FREQUENCY SWEEP AND STABILIZATION OF EMISSION PARAMETERS. Godlevskii, A. P.; Popasov, V. P.; Makogon, M. M. pp 87-90 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of solid state ruby (first case) and neodymium glass (second case) lasers with frequency sweep and stabilization of emission parameters in which homogeneous removal of inverse population and increase of emission stability were accomplished by using a variable-length cavity (maximum rate of change of cavity length greater than 6 m/s). In the first case, multiple frequency tuning during a pulse was achieved in a range of the order of 7 cm^{-1}, which was smooth with a small frequency shift step, as well as all intermediate modes. With respect to energy, the emission was no different from spontaneous emission and was stable up to four times the threshold level. A quasiperiodic emission mode was typical of the second case. The divergence of the emission was stabilized, and amounted to about 3 milliradians. (Referativnyi Zh.)

29461 RUBY LASER EMISSION WITH MONOTONIC VARIATION OF CAVITY PARAMETERS. Klinkov, V. K.; Mukhtarov, Ch. K. pp 84-87 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of emission of a ruby laser with monotonic variation of cavity parameters. Experiments with displacement of the selector in the cavity and movement of one of the cavity mirrors showed appreciable influence of processes of redistribution of energy in the cavity on the mode of emission, and enabled tracking the spectral kinetics of emission in detail. Monotonic variation of the cavity parameters gave emission which was periodic with respect to spectrum and in time, instead of random beams. (Referativnyi Zh.)

29462 CONCERNING THE POSSIBILITY OF MAGNETIC FIELD CONTROL OF RUBY LASER EMISSION FREQUENCY. Valyavko, V. V.; Boyko, B. B.; Petrov, N. S. pp 80-84 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of the influence that magnetic fields of various intensity have on the absorption spectrum of ruby in the region of R-lines at a temperature of 30 ± 0.5°C. An experimental study was made of the case where an ordinary wave propagates in the crystal. The specimens were ruby rods 10 to 15 mm in dia and 60 to 120 mm long with 90° orientation of the optical axis used directly in the laser. The pulse method was used in the experiments. It was established that the magnetic field combined with additional selecting elements introduced into the cavity provided continuous frequency tuning over a range of from ν_0 to $\nu_0 + 13$ cm^{-1}. (Referativnyi Zh.)

29463 INFLUENCE WHICH COMPENSATING FOR THE FREQUENCY DEPENDENCE OF GAIN HAS ON THE EMISSION SPECTRUM OF A RUBY LASER. Lebedev, V. I.; Yasen, A. I. pp 77-80 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of the influence that compensating for the frequency dependence of gain has on the emission spectrum of a ruby laser. Interferograms of eight sequential laser emission pulses in the case where the output mirror was a reflector with parameters $r_1 = 0.7$, $r_2 = 0.04$, $d = 0.01$ cm (r_1 and r_2 are the coefficients of reflection from the mirrors, d is the base) showed that the spectrum consists of randomly varying groups of frequencies. The width of the spectrum varies from 0.3 to 0.05 cm^{-1}, and the center of the line is unstable in position. The reasons for the instability of the spectrum of emission of lasers with nonselective resonator cavity need to be explained. (Referativnyi Zh.)

29464 RESIDENCE TIME OF DIFFUSING PARTICLES IN A FINITE VOLUME. Kostritsa, A. A.; Chekushina, L. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 42-45(1974). (In Russian).

In the case of the appearance of particles in a finite volume of rapidly moving media, the residence time of the particles approaches $l/2u$, where u is the velocity of the medium and l is the dimension of this volume in the direction of motion. The equations derived can be applied to the evaluation of the characteristic residence time of molecules with different quantum levels and considered as the individual components in a high-current gas laser. (JSR)

29465 MULTIPLE-SELECTED-LINE UNSTABLE RESONATOR. Chodzko, R. A. (Aerospace Corp., Los Angeles). Appl. Opt.; 13: No. 10, 2321-2325(Oct 1974).

A new type of unstable resonator was developed that permits multiple-selected-line operation. Selected-line operation is obtained with a diffraction grating that is oriented at an angle that is different from the Littrow angle. Secondary feedback mirrors at the appropriate angles provide an independent three-element cavity for each wavelength selected. The off-Littrow configuration is less efficient than a single-line cavity at the Littrow angle because there are secondary zero-order beams at each wavelength as well as a primary zero-order beam at all selected wavelengths. In the limit of a high gain this loss in efficiency is shown to be significantly reduced. Two types of multiple-selected-line unstable resonators are considered: an edge-coupled design, which produces an annular beam with a 45° output coupling mirror, and a continuously coupled design, which uses the primary zero-order beam as output. Experiments were carried out with a multiple-selected-line unstable resonator on a cw HF laser. Selected-line operation was obtained on the $P_2(5)$ and $P_1(6)$ HF transitions in a continuously coupled design. (auth)

29466 OBSERVATIONS OF ANOMALOUS GAIN COEFFICIENTS IN TEA DOUBLE-DISCHARGE CO_2 LASERS. Singer, S. (Los Alamos Scientific Lab., NM). IEEE J. Quant. Electron.; QE-10: No. 11, 829-831(Nov 1974).

Direct measurements of the gain coefficient of a TEA double-discharge CO_2 laser versus wavelength show that while the overall wavelength dependence is in good agreement with that predicted from the model wherein the rotational levels are in thermal equilibrium, P(20) in the 10.4-μm band and P(22) in the 9.4-μm band have a gain coefficient that is ~10% high. These results are interpreted as evidence for stimulated emission from "hot bands" by these laser lines. Other transitions in these two bands should also exhibit gain coefficients that have been enhanced to a lesser degree. (auth)

29467 TIME RESOLUTION SPECTRA OF $Ga_{1-x}Al_xAs$ SINGLE HETEROJUNCTION LASERS. Li, C. L. (Peking Univ.). Wu-li; 3: No. 3, 145-148(18 Jun 1974).

An experiment using an SQ-5 Sampling Oscillograph to record the time resolution spectra of $Ga_{1-x}Al_xAs$ single heterojunction lasers is described. It was found that there is mode competition. As the pulse current approaches its peak at 27 A, the spectrum changes from a multi-mode to a near single-mode state, the longitudinal modes of the shorter wave take precedence, and the peak of the gain curve shifts towards the shorter wave. After the pulse current passes its peak, the spectrum returns to the multi-mode state, the longitudinal modes shift towards the longer wave, and the peak of the gain curve shifts towards the longer wave. The peaks of two consecutive longitudinal modes are about 2.5 Å apart. All of the longitudinal modes are displaced collectively keeping the same interval between each other beginning after 75 ns and reaching a displacement of about 1.3 Å near 200 ns. When the peak current is at 32 A, filamentary luminescence occurs which produces light spots in the near-field picture. (JPRS)

29468 MEASURING THE GAIN OF CO_2 LASER AMPLIFIERS. Li, C. L.; Chiu, S. Y.; Liu, H. L. (Peking Univ.). Wu-li; 3: No. 3, 151-152(18 Jun 1974).

High power has been achieved from the CO_2 laser by means of a proper mixing of CO_2 with buffer gases of nitrogen and helium. The purpose of this study was to determine what proportion of CO_2-N_2-He mixture yields the maximum gain. Gain versus discharge current for various buffer gases in CO_2 is presented. Gas mixture is optimum for CO_2-N_2-He (1 : 2 : 7) at p = 7.5 torr. Pressure and diameter dependences were investigated. For amplifier tube bore of 27 mm, the optimum pressure is 8 torr, the optimum mixture is CO_2-N_2-He, and the optimum discharge current is 20 mA. (JPRS)

29469 ANALYSIS OF LENSLIKE EFFECTS IN GAS LASERS. Chang, J. L. (Nankai Univ., Korea). Wu Li Hsueh Pao; 23: No. 6, 437-446(Nov 1974).

The optical cavities of general curved-mirrors with a negative lens-like medium are discussed and used to analyze the thermal lensing effects in gas lasers. The mode analysis is made for a cw CO_2 laser of a plane-concave cavity. It is shown that the thermal lensing effects have considerable influence on the output and resonance frequencies, particularly for the fundamental mode lasers. Finally, possible thermal lensing effects in ion gas lasers and other lasers are briefly discussed. (JPRS)

29470 GROWTH AND OPTICAL INHOMOGENEITIES OF YAG SINGLE CRYSTALS. Wu-li; 3: No. 3, 134-138(18 Jun 1974).

Optical inhomogeneities which are formed during the growth of neodymium-doped yttrium aluminum garnet (YAG: Nd^{3+}) single crystals and which impair the lasing capability of the crystals are discussed. YAG: Nd^{3+} single crystals were grown by extraction in

a modified TDK-36AZ furnace for silicon single crystals. It was found that the higher the Nd concentration, the higher the lasing efficiency of the YAG crystals but also the greater the optical inhomogeneity of the crystals. Therefore, as the Nd content is increased, the growth rate of the crystals should be decreased. At the apex of inverted conical solid-liquid boundaries, (211) planes may appear which form nuclei and collateral nuclei. The areas of these nuclei contain high Nd concentrations, high dislocation densities, and great stresses, and produce serious distortions in the laser beams. Growth striations formed by temperature fluctuations produce diffraction and scattering of the laser beams. (JPRS)

29471 COHERENT-INTERACTION EFFECTS IN THE AMPLIFICATION OF SHORT OPTICAL PULSES IN NEON. Odintsov, A. I.; Yakunin, V. P. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 20: No. 4, 102-103(20 Aug 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 4, 233-235(20 Aug 1974).

Modulation of the pulse envelope, a change in the propagation velocity, and a spittling of the spectral band of the pulse were observed in a neon laser amplifier (λ = 5400 Å transition) under conditions when the phase memory of the atoms was preserved during the pulse duration. (auth)

29472 GaAs-DOUBLE-HETEROSTRUCTURE LASERS AS OPTICAL AMPLIFIERS. Schicketanze, D.; Zeidler, G. (Siemens Research Labs., Munich). IEEE J. Quant. Electron.; QE-11: No. 2, 65-69(Feb 1975).

The results of measurements on a GaAs-double-heterostructure (DHS) laser used as an optical amplifier are reported. The laser's amplifying guide is coupled to an optical fiber with a rectangular core. The laser amplifier can be operated either in the traveling-wave or the resonator mode. The gain, noise, and performance of the amplifier when driven hard into saturation were measured as a function of various parameters. (auth)

29473 AMPLIFICATION AND EXCITED STATE ABSORPTION IN LONGITUDINALLY PUMPED LASER DYES. Leheny, R. F.; Shah, J. (Bell Labs., Holmdel, NJ). IEEE J. Quant. Electron.; QE-11: No. 2, 70-74(Feb 1975).

Direct measurements of optical gain using a probe laser beam for the laser dye cresyl violet perchlorate (CVP) in methanol solution using longitudinal pumping at two different wavelengths are described. An analysis of these longitudinal pumping experiments is developed and analytical expressions relating measured gain to the measured pump laser transmission are presented. This analysis is developed in terms of relevant optical cross sections including the influence of excited state absorption. The results demonstrate the influence of excited state absorption at the pump wavelength on pumping efficiency and on the gain per pass at the probe laser wavelength. (auth)

29474 POPOP DYE VAPOR LASER. Smith, P. W.; Liao, P. F.; Shank, C. V.; Lin, C.; Maloney, P. J. (Bell Labs., Holmdel, NJ). IEEE J. Quant. Electron.; QE-11: No. 2, 84-89 (Feb 1975).

A comprehensive study of the operation of a laser using the organic scintillator dye POPOP in the vapor phase is reported. Laser operating parameters have been determined, and tuning experiments which demonstrate an oscillation range of 25 nm are described. Gain measurements as a function of wavelength and time are reported for transverse pumping with the 337.1-nm output of a pulsed N_2 laser. The quantum efficiency has been measured as a function of temperature and pump wavelength, and a preliminary study has been made of the effect of buffer gases on the quantum efficiency and the gain. Spectral condensation measurements show 90% of the broad-band laser output can be obtained in a 1-nm band-indicating that even in a dilute vapor, the thermalization time of the laser levels is $\ll$1ns. The implications of these results for the achievement of an electrically pumped dye vapor laser are discussed. (auth)

29475 PHYSICAL INTERPRETATION OF BISTABLE UNIDIRECTIONAL RING-LASER OPERATION. Hambenne, J. B. (Hughes Aircraft Corp., Tucson, AZ); Sargent, M. III. IEEE J. Quant. Electron.; QE-11: No. 2, 90-92(Feb 1975).

Oppositely directed running waves in a ring laser saturate themselves and one another by population depletion. In addition, as the Doppler broadening decreases, they saturate one another by scattering off induced Bragg gratings in the medium, i.e., off spatial holes burned into the population difference. This increased coupling results in bistable operation near the atomic line center for Doppler-broadened media and for any equal tuning for stationary atoms. (auth)

29476 NEW LASER OSCILLATION IN THE OXYGEN ATOM. Sutton, D. G.; Galvan, L.; Suchard, S. N. (Aerospace Corp., El Segundo, CA). IEEE J. Quant. Electron.; QE-11: No. 2, 92(Feb 1975).

A new laser oscillation has been observed in a pulsed discharge of He and O_2. This oscillation at 2.652 μm has been identified as belonging to the O(I) atom. (auth)

29477 SPECTRAL HOLE BURNING IN DYE SOLUTIONS. Mourou, G. (Laval Univ., Quebec). IEEE J. Quant. Electron.; QE-11: No. 1, 1-8(Jan 1975).

Using picopulses generated by a mode-locked ruby laser, the 3-8-Å bandwidth of a hole burned in the 0–0 transition of cryptocyanine in methanol was measured. The inhomogeneous character of this transition was demonstrated. The population-rate equations are written for an inhomogeneous transition with two and four energy levels interacting with continuous or pulsed excitation. Using the numerical solutions of this model together with the experimental result, a transverse relaxation time T_2 = 0.6-1 ps for cryptocyanine in methanol was determined. (auth)

29478 FLUCTUATION MODEL OF A PASSIVELY MODE-LOCKED LASER. Glenn, W. H. (United Aircraft Research Labs., Hartford, CT). IEEE J. Quant. Electron.; QE-11: No. 1, 8-17 (Jan 1975).

The "Fluctuation Model" for the generation of ultrashort pulses by a saturable absorber has been discussed by a number of authors. This model has provided valuable insights into the mechanisms involved in passive mode locking; however, previous treatments have been incorrect in several important respects. These treatments have attempted to describe the behavior of the laser in terms of the evolution of a statistically independent set of fluctuations (pulses) circulating in the laser. It is shown that such a description is impossible in principle. This paper discusses in detail the problem with the previous treatments and presents an alternate treatment of the evolution of the ultrashort pulses during the nonlinear phase of development. The model is capable of predicting the conditions under which good mode locking will occur, the probability of the appearance of secondary pulses and their relative intensities, the peak intensity of the output pulse train and its statistical variation, and the duration and time of appearance of the output pulse train. The analysis has also been formulated in such a way that the evolution of the signal can be followed by measurement of experimentally observable quantities. (auth)

29479 PULSE STRETCHING AND SHAPE CONTROL BY COMPOUND FEEDBACK IN A Q-SWITCHED RUBY LASER. Lovberg, R. V. (Univ. of California, San Diego); Wooding, E. R.; Yoeman, M. L. IEEE J. Quant. Electron.; QE-11: No. 1, 17-21(Jan 1975).

Feedback control is employed to stabilize the output of a Q-switched ruby laser. A computational model of the rate equations plus feedback terms is used to examine pulse shapes with changing feedback parameters. It is shown that a lengthened flat-top pulse cannot be obtained with negative feedback alone, a compound feedback arrangement is suggested to facilitate this. A practical laser system is constructed with an associated feedback loop, good agreement is found between theory and experiment. Pulses flat to within ±5% are obtained with durations up to 600 ns and are amplified with no apparent saturation. Output powers of 15 MW are achieved for hundreds of nanoseconds with a divergence of 7 mrad and a spectrum consisting of transform-limited lines separated by the axial mode spacing. (auth)

29480 THEORY OF THE MODE-LOCKED, INTERNALLY FREQUENCY-DOUBLED LASER. Falk, J. (GTE Sylvania Inc., Mountain View, CA). IEEE J. Quant. Electron.; QE-11: No. 1, 21-31(Jan 1975).

An AM mode-locked laser with a frequency doubler internal to the laser cavity is analyzed. Mathematical expressions are derived for laser pulsewidth, saturated gain, and second-harmonic output power. It is shown that the maximum second-harmonic power output available from the mode-locked laser is a factor of $\sqrt{2}$ less than that available from an identical free-running laser. Numerical examples are given for an Nd:YAG laser with a $Ba_2NaNb_5O_{15}$ internal frequency doubler. (auth)

29481 PULSE COMPRESSION FOR MORE EFFICIENT OPERATION OF SOLID-STATE LASER AMPLIFIER CHAINS. II. Fisher, R. A. (Univ. of California, Livermore); Bischel, W. K. IEEE J. Quant. Electron.; QE-11: No. 1, 46-52(Jan 1975).

In a previous letter, a compression scheme which reduces the intensity of a laser pulse in an Nd:glass amplifier chain and thereby allows more efficient energy extraction was proposed. In this scheme the nonlinear index of refraction (n_2) of the glass in the amplifier impresses a frequency sweep or "chirp" on the pulse. Further analysis is presented. The stability to amplitude noise is demonstrated. It is calculated that impressed periodic amplitude modulation is responsible for the growth of distinct spectral sidebands in the nonlinear host glass, and that the compressor converts these sidebands into temporal features which precede and follow the central compressed pulse. When a pulse

with 10% peak-to-peak impressed periodic modulation passes through a sufficient length of glass so that the peak nonlinear phase is approximately 4π, these precursors are only about $1/_{25}$th the intensity of the main compressed pulse. RMS equivalent random noise has a flat sideband spectrum, and the precursors are found to be absent in the compressed pulses. The intensity averaging over possible transverse-mode structures is studied for some axially symmetric spatial mode shapes. This averaging somewhat reduces the compression ratio from the estimates in which the transverse modes were flat-topped. Finally, arguments are presented to explain why it is felt that a grating pair is not likely to be a suitable compressor for such intense nanosecond-duration pulses. (auth)

29482 ATOMIC LASER ACTION IN RARE GAS–SF_6 MIXTURES. Sutton, D. G.; Galvan, L.; Valenzuela, P. R.; Suchard, S. N. (Aerospace Corp., El Segundo, CA). IEEE J. Quant. Electron.; QE-11: No. 1, 54-57(Jan 1975).

Pulsed-laser action is described on a number of atomic transitions of ArI, one of which has not been reported previously. The addition of SF_6 to Ar shifts the laser action in the Ar from the $3d'(^3/_2)^0_1$–$4p'(^1/_2)_1$ transition to six ArI transitions originating from the three lowest states of the $3p^53d$ electron configuration. Significant enhancement of the intensity is observed over that resulting from a discharge in pure argon. In addition, when a small amount of SF_6 is added to a He discharge, laser oscillation results from FI at 0.7129 μm. Increased SF_6 pressure produces an unidentified oscillation at 2.639 μm. These last two transitions have been observed also in He-NF_3, He-CF_4, and He-PF_3 mixtures. (auth)

29483 MODE LOCKING THE Nd:GLASS LASER WITH BDN: MEASUREMENTS OF DYE RECOVERY TIMES AND LASER PULSE LENGTHS. Greenhow, R. C.; Street, A. J. (Univ. of York, Eng.). IEEE J. Quant. Electron.; QE-11: No. 1, 59-60 (Jan 1975).

The recovery times for transient bleaching of the Q-switch dye bis(4-dimethylaminodithiobenzil)nickel (BDN) in the solvents dichlorethane and iodoethane have been determined. The lengths of pulses from an Nd:glass laser mode locked with BDN have also been measured by means of the two-photon fluorescence technique. (auth)

29484 NEAR-INFRARED DYE LASER EMISSION FROM ULTRAVIOLET NITROGEN-LASER-PUMPED DYE SOLUTIONS. Lin, C. (Bell Labs., Holmdel, NJ). IEEE J. Quant. Electron.; QE-11: No. 1, 61(Jan 1975).

"Superradiant" near-IR dye laser emission, with peak of emission in the 690 to 930 nm range, from nitrogen-laser (λ = 337 nm)-pumped dye solutions including aluminum phthalocyanine chloride and seven polymethine cyanine dyes is reported. (auth)

29485 OPTIMAL CHARACTERISTICS OF HIGH-PRESSURE METAL VAPOR LASERS. Eletskii, A. V.; Zemtsov, Yu. K.; Rodin, A. V.; Starostin, A. N. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 220: No. 2, 318-321(11 Jan 1975). (In Russian).

The development of techniques of nanosecond discharges in gases and the production of high-power pulse systems with non-self-maintained discharges has opened the possibility of the vapor-metal control of pulse discharges in gases at high pressure. This possibility is analyzed quantitatively using copper vapor lasers as an example. The calculated characteristics are tabulated and show that during excitation of a very dense vapor by electric discharge, generation is not attained. (JSR)

29486 QUASI-STATIONARY WORK MODE OF CO_2 LASER DURING PULSE EXCITATION. Karnyushin, V. N.; Soloukhin, R. I. (Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 220: No. 3, 582-585(21 Jan 1975). (In Russian).

Lasers operating in the steady mode or in the pulse mode have different characteristics and advantages. A laser construction allowing both modes would be advantageous. A possible laser construction of such a combined laser system for a CO_2 laser is described. Some of the discharge characteristics of the proposed laser system are discussed. The cause of instabilities is analyzed. (JSR)

29487 INVESTIGATIONS OF 4416 Å Cd^+ LINE INTENSITY OF A He–Cd DISCHARGE IN A TWO-ANODE DISCHARGE TUBE. Mizeraczyk, J.; Konieczka, J. Pr. Inst. Masz. Przeply.; No. 65, 127-132(1974). (In Polish).

A two-anode discharge tube for ion metal-vapor lasers is described. A diagrammatic arrangement of the tube is shown. Investigations of spontaneous emission intensity of the λ = 4416 Å Cd^+ line in the He-Cd discharge proved that with the discharge tube under consideration it is possible to select, in a straightforward and easy manner, operating conditions of the laser optimum with regard to its output power. The results of the investigations are shown. (auth)

29488 MEASUREMENTS OF TWO-PHOTON-ABSORPTION IN THE CAVITY OF AN ORGANIC DYE LASER. Kleinschmidt, J.; Tottleben, W.; Rentsch, S. (Univ., Jena, Ger.). Exp. Tech. Phys.; 22: No. 3, 191-195(1974). (In German).

An "intra-cavity"-method was used for measurements of two-photon-absorption. This method was proved by measurements of the materials anthracene and stilbene in solution. The results were compared with absorption measurements outside of the laser cavity. (auth)

29489 HIGH POWER CW NOBLE GAS ION LASER. Ebert, W.; Redlich, L. (Central Inst. for Electron Physics, Jena, Ger.). Exp. Tech. Phys.; 22: No. 3, 197-207(1974). (In German).

A high power noble gas cw ion laser tube was fabricated using a graphite segmented structure. The small bore region is 1900 mm long and the inner diameter of the channel is 12 mm. Experiments have been carried out in argon and krypton. Discharge currents up to 300 A and external axial magnetic fields up to 500 Oe were possible to reach. Continuous wave power outputs of 40.7 W at 230 A (Ar II) and 5 W at 150 A (Kr II) were measured. (auth)

29490 INVESTIGATIONS OF SEALED-OFF CO_2 LASERS. Donnerhacke, K. H. (Univ., Jena, Ger.). Exp. Tech. Phys.; 22: No. 5, 415-424(1974). (In German).

The dependence of the output power of a sealed-off CO_2 laser on the discharge current, mixture ratio and total pressure was investigated. The experimental results can be qualitatively well interpreted by taking into account the dissociation of the CO_2 molecule. With the four-component mixture $CO_2 + N_2 + He + Xe$ a maximum output power of 21 W/m discharge length was achieved. In addition, the optimum transmission of the coupling mirror was theoretically investigated. The calculated values are in good agreement with experiments. (auth)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstract 31282.

29491 (AD-786918) EXPERIENCE OF DEVELOPING FORECASTS OF TRENDS IN DEVELOPMENT OF CRYONICS. Stepanov, N. 18 Sep 1974. Translated from pp 293-300 of Teoriya i praktika prognozirovaniya razvitiya nauki i tekhniki v stranakh-chlenakh sev, 1971. (FTD-HC-23-2365-74). 15p. NTIS $3.25.

Cryonics has developed at the junction of solid-state physics, low-temperature physics and cryogenic technology. Among the variety of applications of superconductivity in the field of electronics, electrical engineering and machine construction, the more promising are the four main trends: cryogenic memories, superconducting magnets, superconducting electric transmission lines, sensors and precision measuring devices. This paper discusses these trends. (GRA)

29492 (AD/A-000152) ac 100 kW POWER GENERATOR WITH A SUPERCONDUCTING INDUCTOR. Veselovskii, A. S.; Vorobev, V. F.; Keilin, V. E.; Klimenko, E. Yu.; Kovalev, I. A. Translated by C. M. Barber from Elektrichestvo; No. 5, 28-32 (May 1973). 18p. (FTD-HT-23-1153-74). NTIS $3.25.

The purpose of the work was the creation of an electrical generator with a superconducting inductor with 100 kW power for verification of the work capacity and effectiveness of the basic structural units. In addition, interest was shown in a comparison of the experimental data with the results of the calculations. (GRA)

29493 (AD/A-000283) POWER SPECTRUM OF AN INJECTION-LOCKED JOSEPHSON OSCILLATOR. Stancampiano, C. V.; Shapiro, S. (Rochester Univ., N. Y. (USA)). Oct 1974. Contract N00014-67-A-0398-0003. 20p. NTIS $3.25.

Previous experiments have shown that a Josephson oscillator, exposed to a weak narrow-band input signal, exhibits behavior characteristic of an injection-locked oscillator. When in lock, Adler's theory of injection locking describes the experimental observations reasonably well. The paper extends the range of applicability of the theory to the out-of-lock regime where a spectrum of output frequencies is observed. Obtaining the theoretical output power spectrum requires solving a differential equation having the same form as the equation describing the resistively shunted junction model of Stewart and McCumber. Experimental measurements of the output spectrum of a nearly locked Josephson oscillator are shown to be in reasonable agreement with the theory. Additional results discussed briefly include the observation of a frequency dependence of the locked Josephson oscillator output, and experiments in which a Josephson oscillator-mixer was injection locked by a weak signal. (auth)

29494 (AD/A-000371) PREPARATION AND CHARACTERIZATION OF SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES. Final Report, 16 September 1970–15 September 1974. Moulton, W. G. (Florida State Univ., Tallahassee (USA). Dept. of Physics). 4 Oct 1974. 26p. (AFOSR-TR-74-1723). NTIS $3.75.

The objectives of the research were to prepare magnetic and superconducting materials with unusual properties which will be useful in device applications, and to investigate the properties of these materials. Both experimental and theoretical studies were carried out. Magnetic properties of the rare earth compounds were investigated, and several unusual phenomena were found. Double magnetic phase transitions were observed and studied in cesium nickel trichloride and several other similar crystals. The superconducting properties of the fluoroxy tungsten bronzes were investigated, and a number of new results were obtained. The most recent objectives were to develop low critical current materials useful in new kinds of Josephson devices. (GRA)

29495 (AED-CONF-74-089-052, pp A1-A13) TESTING AND OPERATION OF He-II LOW TEMPERATURE PLANTS. Spath, F. Apr 1974. (In German).

From Spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

With abstract in German and English.

In testing and operation of helium refrigerators for applied superconductivity.

At the institute, two big He II refrigerators are used for research work in the field of superconductivity. This work reports on performance and results of the acceptance tests and the problems encountered during utilization and operation of the refrigerators. For proving the specifications, extensive tests were carried out. The measured capacity at 1.8 K was higher than the guaranteed value. Especially the leak-rate (< 20 Nl/h) and the oil-free compressors were carefully checked. The refrigerator built by Linde delivers 300 watts and has been operated for about 10,000 hrs since 1971. The machine built by Messer Griesheim delivers 350 watts and was put into normal operation in 1974. (auth)

29496 (AED-CONF-74-089-053, pp B1-B7) OPERATING EXPERIENCE GAINED WITH A He–I CYCLE IN A 300-WATT REFRIGERATOR PLANT. Katheder, H. Apr 1974. (In German).

From Spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

With abstract in German and English.

In testing and operation of helium refrigerators for applied superconductivity.

At the institute IEKP-Karlsruhe, a 300-watt refrigerator was put into operation in 1971. For endurance tests of superconducting magnets a 4.4 K refrigeration cycle was installed. The flow diagram used is discussed and experimental data concerning cryostat performance, helium-transfer lines, cool-down mode, cool-down time, energy release into the helium bath and the reaction of the refrigerator are given. (auth)

29497 (BNL-19619) MECHANICAL PROPERTIES OF INSULATING TAPES AT CRYOGENIC TEMPERATURES. Muller, A. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 19p. (CONF-741097-1). Dep. NTIS $4.00.

From Conference of the Society for Electricity and Electronics; Paris, France (14 Oct 1974).

As a result of a survey of some thirty varieties of plastic film, eight materials were found to possess the characteristics that would qualify them as potential candidates for superconducting insulation for use on ac superconducting cables. An evaluation of the dielectric and mechanical properties of these eight tapes was undertaken in order to select the most promising of these candidates as well as to become acquainted with engineering problems facing the designer of insulation for this type of cable. Four of the eight materials were eliminated from further studies since either their dielectric or mechanical characteristics failed to meet requirements. Two of the candidates were fair performers but failed to exhibit qualities that would warrant further development of their insulation properties. Finally, two of the materials, polyethylene and polycarbonate, appeared to have the most potential for development as cryogenic tapes. A program is underway to improve specific properties of these two materials. (auth)

29498 (CEA-CONF-2751) DESIGN AND OPERATION OF A REFRIGERATOR SYSTEM USING SUPERFLUID HELIUM. Claudet, G.; Lacaze, A.; Roubeau, P.; Verdier, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1974. 8p. (CONF-740509-11). Dep. NTIS (US Sales Only) $4.00.

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A new design is proposed which allows for cooling the helium bath at a temperature sufficiently far below T_λ to obtain a good heat transfer. Heat transfer in liquid helium is discussed and the design and operation of the refrigerator are described. (MHR)

29499 (ORNL-tr-2910) CONTROLLED BEHAVIOR OF TWO MULTIPLE SUPERCONDUCTING COILS DURING RETURN TO NORMAL STATE. Bret, J. L.; Develey, G.; Faure, J. P.; Vallier, J. C. Translated by R. G. Mansfield, (Oak Ridge National Lab., TN), from Rev. Phys. Appl.; 9: 931-937(1974). 12p. Dep. NTIS.

In some superconducting coils producing high magnetic fields, the magnetic energies brought into play are sometimes important enough to damage these coils during a transition. A simple process is described for a set of two magnetically connected superconducting electromagnets which allows avoiding any damage by heating during a quench. (auth)

29500 RELAXATION OSCILLATIONS IN POINT–CONTACT JOSEPHSON JUNCTIONS. Taur, Y.; Richards, P.L. (Department of Physics, University of California, Berkeley, California 94720). J. Appl. Phys. 46: No. 4, 1793-1797 (Apr 1975).

Negative resistance regions have been observed on the static $I-V$ curves of point–contact Josephson junctions when dc biased with a low–impedance source. An equivalent circuit model has been developed which successfully explains the experimental results in terms of relaxation oscillations. It is also found that such junctions can be operated either as a one–port amplifier for signals at 5 MHz or as a 36–GHz heterodyne mixer with large conversion gain. (auth)

29501 A UHF SUPERCONDUCTING MAGNETOMETER UTILIZING A NEW THIN FILM SENSOR. Duret, D. (Institut d'Electronique Fondamentale, Laboratoire associé au CNRS, Bâtiment 220, Université de Paris-Sud, 91405 Orsay,France); Bernard, P.; Zenatti, D. Rev. Sci. Instrum. 46: No. 4, 474-480 (Apr 1975).

A new type of thin film superconducting quantum interference device is described. It has many advantages compared to usual ones: higher critical temperature, readily established critical current (any value can be chosen between 0.5 μA and 1.5 μA with a ±0.1 μA accuracy), high reliability, and low cost. This SQUID works with a uhf magnetometer utilizing a 350 MHz pumping frequency. All rf circuits are perfectly matched, and the use of a particular rf detection leads to an improved signal-to-noise ratio. A sensitivity of $2\times10^{-4}\ \phi_0/\sqrt{Hz}$ is easily obtained, with a slew rate of 2500 ϕ_0/sec. (auth)

29502 OBSERVATION OF THE INTRINSIC NOISE OF A THIN–FILM MICROBRIDGE JOSEPHSON JUNCTION. Pei, S.S.; Lukens, J.E. (Department of Physics, State University of New York, Stony Brook, New York 11794). Appl. Phys. Lett. 26: No. 8, 480-482 (15 Apr 1975).

We have measured the intrinsic noise of a thin–film microbridge Josephson junction included as part of a closed superconducting ring. This microbridge, which was fabricated using electron beam lithography and has submicron dimensions, exhibited a noise magnitude which was in excellent agreement with that predicted for an ideal Josephson junction. (auth)

29503 MEASUREMENT OF 50 Hz ALTERNATING CURRENT LOSSES ON SUPERCONDUCTING NIOBIUM CYLINDERS. Penczynski, P. (Siemens A. G., Erlangen (F. R. Germany). Forschungslaboratorium). Siemens Forsch.-Entwicklungsber.; 2: No. 5, 296-304(1973).

For the development of a superconducting high-power three-phase cable, various types of niobium conductors were studied and their a.c. behavior was investigated. The a.c. losses were determined and the following quantities were studied: (a) the Meissner currents preventing magnetic flux penetration of external fields for field strengths less than H_{c1}, (b) the surface currents screening the superconductor volume from changes of the externally applied field for a field strength less than ΔH (c) the critical current density determining the flux distribution inside the superconductor volume. (GE)

29504 STATE OF THE ART OF LABORATORY SCALE SUPERCONDUCTIVE MAGNETS. Wheatley, R. W. (Oxford Instrument Co. Ltd. (UK). Cryomagnetic Systems Div.); Schaefer, K. (Oxford Geraete G.m.b.H., Neu-Isenburg (F. R. Germany)). Kerntechnik; 16: No. 12, 523-527(Dec 1974).

After a brief historical introduction, the article gives a comprehensive list of commercially available superconducting materials and outlines the most important parameters for winding these materials into superconducting magnets. A technical appraisal of the suitability of the type of materials listed to the needs of the magnet designer follows. Cryostatic, dynamic and adiabatic stabilization are discussed in detail with emphasis on the results obtainable with filamentary NbTi. Some applications are discussed. Developments involving new materials–particularly filamentary Nb_3Sn–point to the future state-of-the-art of superconducting magnets which will meet the needs of new research

techniques. Finally, some curves are presented showing the variation of the most important design parameters with cost. (auth)

29505 OSCILLATIONS OF THE CRITICAL TEMPERATURE IN TIN-FILM LAYER SUPERCONDUCTOR-DIELECTRIC STRUCTURES. Golyanov, V. M.; Mikheeva, M. I.; Tsetlin, M. B. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 2, 736-742(Feb 1975). (In Russian).

Several extremes in the dependence of the critical temperature T_c on dielectric covering thickness d_c were observed in molybdenum films doped with carbon and technetium films, for $0 < d_c < 20$ Å. Artificial diamond films are used as the covering. The critical temperature of technetium films also depends in a nonmonotonous manner on the thickness of the diamond sublayer d_0. The positions of the extremes of function $T_c = f(d_c)$ only weakly depend on the material of the superconducting film and do not depend on its thickness. The positions of the extremes on the $T_c = f(d_0)$ curve are determined by the thickness of the outer dielectric covering. (auth)

29506 THIN FILM SUPERCONDUCTING QUANTUM INTERFERENCE DEVICE WITH A LARGE MEASURING RANGE. Riesenberg, R.; Richter, W.; Albrecht, G. (Univ., Jena, Ger.). Exp. Tech. Phys.; 22: No. 5, 441-445(1974). (In German).

Results of a study with a type of superconducting quantum interference device (SQUID) consisting of thin superconducting layers are presented. Josephson-junctions and Dayem-bridges were used in the study. A multilayer-system consisting of In and Pb for the Dayem-bridges makes possible critical currents of about 10^{-4} A at temperatures of 4.2°K. 10^5 quantum interference periods were measured digitally using the field modulation method. With the aid of a substance with high permeability building into the SQUID area, the magnetic field sensitivity is 10^{-11} T with a time constant of $\tau = 1$ s. (auth)

29507 DETECTION OF MILLIMETER AND SUBMILLIMETER EMISSION BY MEANS OF JOSEPHSON JUNCTIONS. Antyukh, E. V.; Livin, Yu. Ya.; Nad, F. Ya. pp 58-59 of Vsesoyuznii Simpozium po Rasprostraneniyu Submillimetrovykh i Millimetrovykh Voln v Atmosfere Zemli i Planet, 1974. Moscow; Tezisy Dokladov (1974). (In Russian).

A theoretical and experimental study is made of processes of detecting millimeter and submillimeter emission by Josephson junctions — superconductive bridges and point contacts. Experimental studies of sensitivity were done on a receiver model for which several designs were developed and built of superconducting point contacts in helium. Data are presented on the manufacture, preparation and assembly of the device, its parameters and stability. The spectral dependence of sensitivity is measured in the frequency range of 5 to 30 cm^{-1}. The values obtained (10^4 V/W in the vicinity of ~5 cm^{-1}) are not the limiting values. Reduction of noises and pickups in the measurement circuits to the level of the inherent noise of the contact, as well as reduction of losses in the transmission of radiation will increase the effective sensitivity. (Referativnyi Zh.)

29508 SYSTEM WITH THE NUCLEAR MAGNETIC RESONANCE TRANSDUCERS FOR SPACE DISTRIBUTION MAGNETIC FIELD MEASURING OF SUPERCONDUCTIVE ELECTROMAGNET. Troitskii, A. M. Tr. Radiotekh. Inst.; No. 11, 165-170(1972). (In Russian).

A precision system for the measurement of the magnetic field using the nuclear magnetic resonance is described. The field was measured by means of fixed transducers placed along the space to be measured and connected alternately to the autodyne detector. The detector is external to the field and placed at a distance of 4 m. Oscillations in the autodyne detector are excited in the second mode of the complex resonance circuit. An improvement of the signal/noise ratio is achieved by use of comb filters in the low-frequency circuit of the detector. The instrument is used for the measurement of fields with inhomogeneities up to 0.005 I/cm with a precision of at least 10^{-4}. (tr-auth)

29509 JOSEPHSON EFFECT IN WIDE-AREA SUPERCONDUCTING JUNCTIONS. Aslamazov, L. G.; Larkin, A. I. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 2, 766-775(Feb 1975). (In Russian).

The motion of quantum vortexes in superconducting junctions of a size exceeding that of the pair was investigated. The volt-ampere characteristic of the junction was obtained. The harmonic amplitudes of the alternating voltage arising at the junction for a current exceeding the critical current are calculated. The magnitude and shape of the steps on the volt-ampere characteristic of the junction located in an external alternating electromagnetic field are determined. (auth)

29510 NONEQUILIBRIUM STATES IN SUPERCONDUCTING TUNNEL STRUCTURES. Volkov, A. F. (Inst. of Radio Engineering and Electronics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 2, 756-765(Feb 1975). (In Russian).

Tunnel superconducting structures $S'-S-N$ and N_1-S-N_2 are considered. By neglecting energy relaxation processes, equations are obtained which describe the evolution of order parameter Δ in superconductor S on flow of current in such systems. The rate of variation of the gap $\delta|\Delta|$ and phase δ arg Δ of the order parameter are found in the presence of a direct, sinusoidal (with frequency $\Omega = \Delta$) or δ-like currents. The gap in S decreases in the presence of a current irrespective of its direction. Variation of the phase in S results in the appearance of a potential difference between the superconductor S and measuring electrode N_{meas} separated from S by a thin insulating layer. (auth)

29511 HIGH FIELDS IN SUPERCONDUCTING MAGNETS ON THE BASE OF NIOBIUM-TITANIUM ALLOYS. Bartusch, P. (Central Inst. for Solid Matter Research, Dresden); Gbuenberger, W.; Lange, F.; Berthel, K. H. Exp. Tech. Phys.; 22: No. 3, 209-217(1974). (In German).

From the critical current of niobium-titanium alloys attainable in high magnetic fields the maximum economical possible field of superconducting solenoids made from this material was evaluated for temperatures of 4.2°K (9 Tesla) and 1.5°K (12 Tesla). Ferromagnetic pole pieces give additional fields of 5 Tesla (iron-cobalt) respectively 7 Tesla (dysprosium). In this manner the maximum attainable field is 19 Tesla. (auth)

29512 SUPERCONDUCTIVE LENSES IN AN ELECTRON MICROSCOPE. Pavlik, K. (CSAV, Brno). Slaboproudy Obz.; 34: No. 9, 405-416(Sep 1973). (In Czech).

Recent cryoengineering methods result in exceptional facilities of creating extremely strong magnetic fields, using superconductors at the temperature of liquid helium. One branch in this field, namely on the state of the art of superconductive magnetic lenses in electron microscopes, is discussed. Special problems of designing and working superconductive lenses are described, and their types and construction treated. (Elec. Electron. Abstr.)

Heat Transfer and Fluid Flow

Refer also to abstracts 29351, 29358, 29389, 31841, 31860, 32200, and 32207.

29513 (CEA-CONF-2756) EXPERIMENTAL STUDY OF EVAPORATION HEAT TRANSFER IN A FALLING FILM. Abou, P.; Huyghe, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 18p. (CONF-7404101-1). Dep. NTIS (US Sales Only) $4.00.

From symposium on multi-phase flow systems; Glasgow, UK (2 Apr 1974).

The local heat transfer coefficient for the evaporation of water falling in a film was studied experimentally. Tests were made with electrically heated tubes 3.6 m long and of 28.5 and 36 mm inside diameter. The temperature varied from 40 to 110°C, the linear mass flow rate from 0.5 to 1.5 kW/ms and the heat flux from 15 to 75 kW/m^2. Simultaneous measurements of the wall temperature of the tube and of the pressure drop inside of it were made. The results are correlated by the way of dimensionless parameters Nu, Pr, Re_f, Re_v, (respectively the Nusselt and Prandtl numbers of the film, and both the Reynolds numbers of the film and of the core of vapor). (auth)

29514 (CEA-N-1776) CALCULATION PROGRAM FOR FAST NONSTEADY FLOWS: REBECCA CODE. Dobremelle, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Dec 1974. 32p. (In French). Dep. NTIS (US Sales Only) $4.75.

The computer code REBECCA used for solving equations for one-dimensional unsteady gas flow through pipes, containers, nozzles, diaphragms, and sudden expansions or constrictions is presented. The characteristics method is used for the solution. (auth)

29515 (FEI-459) TOWARD METHODS OF MEASUREMENT OF LOCALIZED TEMPERATURE DURING BUBBLE BOILING IN LARGE VOLUME. Sorokin, D. N.; Tsyganok, A. A.; Mityaev, N. N.; Gribov, A. A.; Gulyaev, V. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The basic questions connected with the methods of making tests and processing data on the measurement of local instantaneous temperature in liquids and heat-transfer surfaces during bubble boiling were examined. The characteristics and construction of microthermometers are described. The characteristics of the other apparatus used during experimental measurements are discussed. (tr-auth)

29516 (NASA-CR-54441) HEAT TRANSFER TO A GAS CONTAINING A CLOUD OF PARTICLES. Semiannual Status Report No. 6. McAlister, J. A.; Keng, E. Y. H.; Orr, C. Jr. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 30 Jul 1965. Contract NsG-273-62. 36p. Dep. NTIS $5.00.

The basic radiation equations were solved to describe the radiant heat transfer from a black, cylindrical enclosure uniformly radiating to a black, evenly dispersed particle cloud contained within. Back thermal radiation and radiation scattering were considered negligible. The solution was presented graphically in generalized form with all variables being dimensionless quantities, and comparisons with experimental data were shown. Equations were also presented for calculating the radiation absorbed by a particle cloud within unheated segments of the enclosure adjacent to the radiating element. A brief description of particle deagglomeration and cloud transmissivity studies was included. (auth)

29517 (RN-TM-0239) IDEAL SONIC VELOCITY AND OTHER FLOW PARAMETERS FOR TWO PHASE PARAHYDROGEN. Gordon, L. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 23 Aug 1965. 54p. Dep. NTIS $5.75.

Results of calculations of sonic velocity and other parameters for idealized flow of two-phase parahydrogen are presented. These calculations were made as part of an analysis effort leading toward development of a hydrogen pump to be used in a nuclear rocket and which will have a high pumping efficiency at low or zero values of net positive suction pressure. The temperature and pressure ranges for which these calculations were made are typical of those to be found in nuclear rocket operation. Calculations were made with a digital computer using thermodynamic properties taken from NBS Report 7987, and fitted for the limited range of 10 to 50 psia only. From these fitted data, tables of properties were prepared for a list of pressures, and then properties at each of these pressures along an expansion path were calculated by standard methods. With respect to the two-phase flow, this method has two fundamental implications: (1) for any given pressure and enthalpy, the fluid quality is the same as for a static equilibrium condition; (2) the liquid and vapor velocities and temperatures are always equal throughout the expansion. Otherwise, all calculations were made just as for a single phase fluid. (auth)

29518 (WANL-TME-820) HYPERSONIC REENTRY AERODYNAMICS OF BLUNT BODIES BY THE METHOD OF BELOTSERKOVSKII. Doby, R.; Siriano, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 37p. Dep. NTIS $5.00.

One of the problems that the flight safety program considers is that of reentry of an intact reactor-vehicle at hypersonic speeds. At these speeds, a detached bow shock wave is formed in front of the vehicle which produces large pressure and temperature ratios across the shock. These quantities then enter into stability considerations (aerodynamic forces) and heat rates (temperatures) of the reentering vehicle. A method of integrating the equations of motion of a compressible gas is presented. Basically the method consists of putting the pertinent equations into "divergence form" and integrating the equations across the shock thickness. Any desired degree of accuracy can be obtained by dividing the shock layer into strips so that the integration proceeds in smaller increments. However, the price one pays for this is an increase in the number of differential equations by a factor of 3N where N is the number of strips. The result of this integration yields a set of ordinary differential equations which can be solved by standard finite difference schemes. These ordinary differential equations are in terms of the independent variable which should be body oriented, although this is not necessary. The solution of these equations yields the aerodynamic forces on the body. The heat rates to the body are obtained by consideration of the boundary layer equations (to be considered in a future report). However, the boundary layer solutions depend upon the inviscid flow equations which is the essence of this report. (auth)

29519 (WANL-TNR-183) SUPERSONIC FLOW FIELD ANALYSIS OF ARBITRARY BLUNT BODIES. Doby, R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1964. 57p. Dep. NTIS $6.00.

An analysis of the inviscid gas dynamics of a blunt nosed body reentering the atmosphere at supersonic speeds is presented. A generalized body oriented coordinate system that provides the ability to analyze axisymmetric flow fields pertaining to a large class of bodies of revolution is featured. The bodies of revolution that are considered include a catenary, ellipse, sphere and flat-faced cylinder. Comparison between experiment and the predictions made by this theory indicates excellent agreement. Additional computations are done using a spherical coordinate system. Due to the fact that the attendant boundary conditions on the body change in such a coordinate system, the amount of computing increases appreciably. In addition, when the boundary layer is considered, the spherical coordinate system becomes less attractive. The numerical accuracy using either coordinate system is about the same. (TFD)

29520 NEW WAYS OF PREDICTING HEAT-TRANSFER PERFORMANCE. Spalding, D. B. (Imperial Coll. of Science and Technology, London (UK)). Chem.-Ing.-Tech.; 46: No. 23, 969-975(Dec 1974). (In German).

Until recently, heat-transfer equipment had to be designed on the basis of correlations of past experimental data, generalized by way of dimensional analysis. These correlations were essentially algebraic relations, connecting resistance coefficients with local conditions. It is becoming increasingly possible to replace the correlations by computer models of the heat-transfer processes. Thus the basic information is incorporated into a computer program which solves the differential equations and reproduces the heat flux at the wall for whatever boundary conditions are applicable. Computer models are now available for two-dimensional and three-dimensional flows, and these make it possible to dispense with the expensive experiments which would be needed if correlation formulae were to be devised. (auth)

29521 CALCULATION BY THE FINITE ELEMENT TECHNIQUE OF STEADY-STATE OR TRANSIENT HEAT-FLOW CONDUCTION. Juignet, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Bull. Inform. Sci. Tech. (Paris); No. 197, 57-60(Nov 1974). (In French).

The computer program DELFINE is presented. The method is based on the finite element technique. Plane and axisymmetric bodies can be investigated. This program gives the solution of thermal problems for the cases of steady-state or transient heat flow in the presence of heat transfer and thermal conductivities depending on the temperature. Two examples are included. (FR)

29522 TWO-PHASE CRITICAL FLOW RATES. Boure, J.; Reocreux, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Transferts Thermiques). Bull. Inform. Sci. Tech. (Paris); No. 197, 21-35(Nov 1974). (In French).

The main experimental and theoretical results of a study of two-phase steam-water critical flow rate are given. The test apparatus and test-sections are first described. The experimental results are then given and discussed: piezometric lines, void-fraction profiles, thermodynamic nonequilibrium, influences of nonequilibrium on critical flow. The main characteristics of the mathematical model used in the theoretical study are given. The conditions which must be verified for the flow to be critical are established. The physical interpretation of these conditions leads to a new formulation of the transfert laws between phases. These laws appear to have a strong influence on critical flow. (FR)

29523 TWO-PHASE FLOW MEASUREMENTS. Delhaye, J. M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Transferts Thermiques). Bull. Inform. Sci. Tech. (Paris); No. 197, 5-20(Nov 1974). (In French).

The methods used to measure the following quantities are described briefly: amount of one phase present over a segment or in a section; mean liquid phase velocity in a section; quality; total mass flow rate; local void fraction; local liquid velocity; and local temperatures of each phase. The methods or instruments involved are as follows: X- or γ-ray absorption; electromagnetic flow meter; turbine flowmeter; variable pressure-drop meter; hot-wire anemometry; resistive probes; phase indicating micro-thermocouple; and optical probes. (FR)

29524 FREE-CONVECTION IN ANNULAR SEMI-CONFINED GAPS. Mejane, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Bull. Inform. Sci. Tech. (Paris); No. 197, 37-44 (Nov 1974). (In French).

Typical flow patterns due to free convection are discussed in cooled vertical gaps closed at the top and opened at the bottom into a reservoir hot fluid. This sort of annular gap is located in the argon cover of liquid metal fast breeder reactors. Flow visualization techniques are used to study the flow patterns in two experimental equipments. Typical flow patterns observed are: bidimensional flow with disturbances and stagnant portion; tridimensional flow in open cells; and tridimensional flows with large random fluctuations. (FR)

29525 FLOW: ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY. Volume I. Part II. Flow Measuring Devices. ASME Fluids Engineering Conference, Pittsburgh, Pennsylvania, May 9-14, 1971. Wendt, R. E. Jr. (Ed.). Pittsburgh; Instrument Society of America (1974). 589p. (CONF-710507-P1,P2).

Sixty-eight papers on flow measuring devices are presented. A separate abstract was prepared for one paper. The remaining 67 papers are not in scope for NSA. (LCL)

For an abstract of an individual paper see: 29530.

29526 FLOW: ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY. Volume I. Part I. Flow Characteristics. ASME Fluids Engineering Conference, Pittsburgh, Pennsylvania, May 9–14, 1971. Stoll, H. W. (Ed.). Pittsburgh; Instrument Society of America (1974). 498p. (CONF-710507-P1).

Forty-seven papers on fluid flow characteristics, velocity and pressure measurements, and measurements in fluid mechanics are presented. A separate abstract was prepared for 2 papers. The remaining 45 papers are not in scope for NSA. (LCL)

For abstracts of individual papers see: 29528 and 29529.

29527 EFFECT OF THE INITIAL HEAT RELEASE LEVEL ON UNSTEADY CRITICAL HEAT FLUX. Tolubinskii, V. I.; Ostrovskii, Yu. N.; Pisarev, V. E. (Inst. of Industrial Heat Physics, Kiev). Teplofiz. Teplotekh.; No. 27, 56-59(1974). (In Russian).

Experimental data are reported on unsteady critical heat flux for acetone and ethanol as a function of the original level of heat release and pressure. An effect, complex in nature, of the original level of heat release and pressure on the unsteady critical heat flux was detected. (tr-auth)

29528 DETERMINATION OF LOCAL VALUES OF GAS AND LIQUID MASS FLUX IN HIGHLY LOADED TWO-PHASE FLOW. Burick, R. J.; Scheuerman, C. H.; Falk, A. Y. (Rocketdyne/North American Rockwell Corp., Canoga Park, CA). pp 153-160 of Flow: Its Measurement and Control in Science and Industry. Vol. I, Pt. I. Stoll, H. W. (ed.). Pittsburgh; Instrument Society of America (1974).

From symposium on flow–its measurement and control in science and industry; Pittsburgh, Pennsylvania, USA (9 May 1971). See CONF-710507-P1,P1.

Results are presented of an experimental program to develop a measurement system that is capable of determining local values of gas and liquid mass flux in highly loaded two-phase flowfields; i.e., (gas/liquid) sprayfields that are characterized by high local liquid/gas mass flux ratios of up to 20 and droplet number densities of up to about $10^9/ft^3$. In the measurement system, a deceleration probe is utilized for the determination of local values of gas phase dynamic pressures and liquid mass flux. A critical component of the probe is a specially designed tip that prevents the passage of water (termed flooding) into a pressure port when the probe is utilized in high pressure, high mass flux ratio flowfields. The problem of flooding is a serious limitation of the probe design of Dussourd and Shapiro. The described system was employed to characterize numerous two-phase flowfields that were generated by gas/liquid rocket motor injectors. Measurements were made in the sprayfields of the injectors at static pressures up to 500 psia and injected mass flow ratios up to 20. These data were employed for a priori predictions of rocket motor performance and chamber wall heat flux levels. (auth)

29529 EFFECT OF SLOPE ON FRICTION OF AIR–WATER MIXTURES IN PIPE FLOW. Mathers, J. L. (Villanova Univ., PA). pp 167-173 of Flow: Its Measurement and Control in Science and Industry. Vol. I, Pt. I. Stoll, H. W. (ed.). Pittsburgh; Instrument Society of America (1974).

From symposium on flow–its measurement and control in science and industry; Pittsburgh, Pennsylvania, USA (9 May 1971). See CONF-710507-P1,P1.

Air-water mixtures with volumetric flow rate ratios ranging from $1/_{65}$ to $1/_2$ were studied in a 3.25-in. ID, 28-ft long aluminum pipe. The head loss (H_f) and Darcy-Weisbach friction factor (f) of the mixture were computed for 4 pipe slopes–0, 30, 45 and 90–with several runs made at 60 degrees. Two lucite viewing sections located upstream and downstream of the test reach permitted visual observation and photographs to be taken. There was good agreement between the measured values of H_f and f and those computed from various prediction methods for mixture flow in a horizontal pipe. Values in a vertical pipe were comparable to the limited data available. The values of H_f and f: were greater at a given slope for mixture flow than for water flow alone; increased at a given slope with increased air-water ratios; were a minimum at 0 degrees, increased with slope up to 45 degrees and then decreased with slope up to 90 degrees for a given air-water ratio; were greater at 90 degrees than at 0 degrees; and depended on the flow patterns encountered. There is a definite correlation between the pipe slope, air-water mixture ratio, flow pattern, head loss and friction factor. (auth)

29530 TRACER METERING OF COMPRESSIBLE FLUIDS. Uhl, A. E. (Bechtel Inc., San Francisco). pp 809-821 of Flow: Its Measurement and Control in Science and Industry. Vol. I, Pt. II. Wendt, R. E. Jr. (ed.). Pittsburgh; Instrument Society of America (1974).

From symposium on flow–its measurement and control in science and industry; Pittsburgh, Pennsylvania, USA (9 May 1971). See CONF-710507-P1,P2.

The theory of tracer flow is cited to indicate the mechanism by which a flow tracer can be used in a pipeline to time the speed of the carrier medium for metering purposes. Experience with three gaseous tracers is surveyed. Anhydrous ammonia, ^{41}Ar, and nitrous oxide have been used with varying degrees of success for determination of flow rates of gas in pipelines. Results of tests with these tracers are reviewed. Several recently developed tracer techniques for compressible fluid metering are summarized. (auth)

29531 FLOW: ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY. Volume I. Part III. Flow Measurement and Control and Biological Fluid Flows. ASME Fluid Engineering Conference, Pittsburgh, Pennsylvania, May 9–14, 1971. Vannah, W. E.; Wayland, H. (Eds.). Pittsburgh; Instrument Society of America (1974). vp. (CONF-710507-P1,P3).

Forty-five papers on fluid flow control systems and biological fluid flows are included. (LCL)

29532 CRITICAL FLOW CONDITIONS IN NON-EQUILIBRIUM TWO-PHASE MEDIA. Konorski, A. Pr. Inst. Masz. Przeply.; No. 65, 3-30(1974). (In Polish).

In the paper the occurrence of critical conditions ("flow choking") in non-equilibrium two-phase flows (in particular wet steam flows) is analyzed. The aim of the paper is to evaluate methods for determining and calculating the thermogasdynamic functions and characteristic parameters and to use them for description of general properties of such kind of flows. A one-dimensional stationary flow of wet steam, containing liquid drops of various sizes and physical parameters (i.e., belonging to various fractions) is considered. Deviations from the internal equilibrium are described by formulas; their influence on the flow is expressed (basing on the author's previous papers) by introducing fictitious functions called "substitutive internal sources" of energy, substance and momentum. These substitutive sources simulate the influence exerted on the gas-phase flow (i.e., flow of the carrier component) by the actual exchange processes with drops of liquid. (TFD)

Materials Testing

Refer also to abstracts 29576, 30172, and 30263.

29533 (CEA-CONF-2635) APPLICATIONS OF ACOUSTICAL HOLOGRAPHY. Touffait, A. M. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). May 1974. 17p. (In French). (Conf-740982-1). Dep. NTIS (US Sales Only) $4.00.

From course on nondestructive control by special techniques; Lyon, France (24 Sep 1974).

Two types of holographs—one for holography in real time and the other for scanning holography—are briefly described. The operation and the recording of the hologram for the scanning holograph are reported. The apparatus for the reconstruction of the hologram is described. Examples are given of the application of acoustical holography to the examination of Al and steel blocks. (JSR)

29534 (CEA-CONF-2888) RADIOACTIVE TRACER METHOD FOR NDT OF AIRCRAFT TIRES. Boutaine, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). [nd]. 14p. (CONF-7410108-1). Dep. NTIS (US Sales Only) $4.00.

A new nondestructive radioactive tracer technique has been developed for the evaluation of the quality of aircraft tires before each retreading. This method derives from the well known needle-test. Its goal is to evaluate the global fatigue of the tire and to detect local defects of the internal structure, such as unbondings between tread and carcass or between the plies, and also local increases of internal porosity. It presents no danger of degradation of the quality of the tire itself and no risk of contamination or irradiation for the staff who carries out the tests or uses the tires afterwards. The principle of the method, the control procedure and the experimental apparatus are described. Some typical results are discussed. Such a method permits the definition of quantitative criteria of acceptance or rejection for each type of tires as a function of their number of landings and their number of retreadings. (auth)

29535 (TID/SNA-710) STRESS-WAVE ANALYSIS TECHNIQUE FOR DETECTION OF INCIPIENT FAILURE. Green,

A. T.; Hartbower, C. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1967. 64p. Dep. NTIS $6.25.

Research has shown that crack growth resulting in a sudden release of elastic energy can be detected by a sensor that converts the elastic wave into an equivalent electrical signal. Thus, this technique is unique as a nondestructive inspection method in that the growing defect in the material transmits its own signal, with the sensor acting as the receiver. The receiving sensors used in our studies and applications have been piezoelectric accelerometers, directly calibrated in engineering units. The Stress-Wave Analysis Technique (SWAT) has been employed as a research tool aimed at learning more about the causes of slow crack growth, particularly as affected by fatigue, hydrogen embrittlement, stress corrosion cracking and spontaneous strain aging. SWAT is now being employed as a field inspection and monitoring process during the pressure qualification testing of rocket motor cases and other pressure vessels. With SWAT one can not only determine if there is a growing flaw, but can also locate the flaw by triangulation techniques. Moreover, in most structures as the crack increases in length, there is an increase in the rate and amplitude of stress-wave emission that presages failure. (auth)

29536 DETERMINATION OF THE OPTIMUM CONDITIONS REQUIRED FOR ACCURATE MEASUREMENTS OF THE TRANSVERSE DIMENSIONS OF INNER CAVITIES IN VARIOUS OBJECTS BY SCANNING WITH A NARROW BEAM OF IONIZING RADIATION. Mukomel, E. A.; Latyshev, V. K. (Inst. of Central Scientific-Research of Ferrous Metallurgy, Moscow). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 3, 291-297(1974).

Translated from Defektokopiya; 10: No. 3, 58-66(1974).

The possibility of ensuring optimum conditions for accurate measurements of the transverse dimensions of inner cavities in various objects when scanning these with a narrow beam of ionizing radiation by appropriately selecting the beam width and the time constant of the integrator is demonstrated. A calculation of the current method of recording is presented, and relationships are derived for the metrological characteristics of the method. (auth)

29537 SOME ALGORITHMS RELATING TO THE ANALYSIS OF RADIOMETRIC INFORMATION IN PROBLEMS OF RADIATION FLAW DETECTION. Butakova, G. E.; Pokrovskii, A. V. (Inst. of Scientific-Research of Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 3, 286-290(1974).

Translated from Defektokopiya; 10: No. 3, 52-58(1974).

A number of algorithms intended for the automatic analysis of radiometric information are presented; these remain valid when the statistical characteristics of the process under consideration vary over a wide range during the recording of the bremsstrahlung beam of a betatron. The working characteristics of algorithms realizing ordinal criteria (algorithms stable with respect to changes in the type of distribution and its parameters) are determined. (auth)

29538 CHARACTERISTICS OF BREMSSTRAHLUNG REFLECTED FROM SOLID BODIES ENCLOSED IN THIN CASINGS. Golikov, E. G.; Sukhanova, K. A.; Bulatov, B. P. (Ural Polytechnical Inst., Sverdlovsk, USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 10: No. 3, 281-285(1974).

Translated from Defektokopiya; 10: No. 2, 47-52(1974).

The energy and angular characteristics of betatron bremsstrahlung reflected by heterogeneous objects of the casing-filler type have been studied experimentally. The possibilities of qualitative and quantitative inspection of a filler hidden within a casing have been investigated in a case when only one side of the object is accessible for testing. (auth)

29539 EVALUATION OF AN INTENSIFIER FOR ^{14}C AND ^{3}H AUTORADIOGRAPHY. Meeks, M. J.; Kessler, W. V.; Born, G. A.; Landolt, R. R. (Purdue Univ., Lafayette, IN). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 87-88(Feb 1975).

A study, designed to show the effects of a preparation recommended by the supplier as an autoradiographic intensifier for weak β-particle emitters, is reported. ^{14}C and ^{3}H labeled compounds were used for the evaluation. It was shown that when the recommended film and exposure temperature were used, the intensifier greatly increased the darkening and detection sensitivity for ^{3}H spots. However although the intensifier is recommended for weak beta-emitting nuclides in general, no increase in sensitivity was noted for ^{14}C spots. A small increase in darkening was observed in ^{14}C spots containing greater than 2 nCi. Exposure at -75°C was found to be essential to obtain enhancement for tritium. (UK)

29540 DESIGN, MANUFACTURE AND NONDESTRUCTIVE TESTING OF THICK "MULTIWALL" TYPE VESSELS. Leymonie, C.; Samman, J.; Hennion, J. (Societe Babcock-Atlantique, 44 - Saint-Nazaire (France)). Rev. Met. (Paris); 71: No. 9, 665-681(Sep 1974). (In French).

From Autumn meeting on metallurgy; Paris, France (1 Oct 1973).

The "multiwall" technique allows thick tanks to be manufactured by the fitting together of moderately thick (40 to 50 mm) ring elements. This arrangement offers considerable advantages over solid-wall constructions: greater safety in operation; possibility of using more resistant steels with mote homogeneous properties; and improved testing of the longitudinal joints which suffer the greatest stress. Different materials may be used for the successive sleeves, which simplifies the design of corrosion-resistant vessels (with special reference to the action of hydrogen at low and high temperature). Machining and filling of grooves between the layers improves non-destructive interlayer testing which must be of a very high standard for equipment subjected to thermal shocks or working at low temperature. The manufacture of very thick vessels (approximately 400 mm) operating at low temperature (approximately -30 deg C) has led to the setting up of defect tolerance criteria based on the mechanics of rupture and to the development of original ultrasonic testing methods to determine the size of defects in the direction of the thickness. (FR)

29541 A METHOD AND DEVICE FOR MOVING-EMITTER RADIOGRAPHY. Dermont, L.; Guerin, A.; Kerlau, J.; Lannes, A. (to CEA, 75 - Paris (France)). French Patent 2,188,862/D/. 15 Jun 1972. 14p. (In French).

This device, comprising an x-ray emitter carried by a movable carriage, a fixed object carried by a tray and a recording film carried by a movable carriage, is characterized in that it comprises means adapted to render the film rectilinear movements dependent on the rectilinear movements of the x-ray emitter, in such manner that these respective movements are in opposite directions and that the ratio of the relative velocities of these movements is equal to the emitter-film spacing/emitter-object spacing ratio, on the one hand and oleopneumatic means adapted to provide the x-ray emitter with a wide range of velocities. This device can be applied to the radiography of reactor fuel elements. (FR)

29542 DENSITOMETRIC MEASUREMENT OF THE THICKNESS OF DEFECTS DETECTED BY GAMMAGRAPHY ON CAST URANIUM ALLOY PARTS. Beaubron, A. (CEA Centre d'Etudes de Valduc, 21 - Is-sur-Tille (France)). pp 76-80 of 3. Colloquium on Non-Destructive Testing Methods, 14-16 May 1974. Issy-les-Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French)

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

When high-resistance alloys are used it is necessary to know exactly the size of a defect according to the thickness of the part. The thickness of a flaw detected on a radiographic film can be determined quantitatively by optical density measurements. The local increase in density provided by a hole depends linearly on the thickness of the defect. This method was applied systematically on flaws detected by gammagraphy of cast uranium and plutonium alloy parts. The results obtained on a 10 mm thick hemisphere of U-0.2% V by weight, provided with a flat-bottomed reference holes, are presented. (FR)

29543 LOCAL HOMOGENEITY INSPECTION OF MOLDED MATERIALS BY MEASUREMENT OF MONOCHROMATIC X-RAY ATTENUATION. Huet, J. (CEA Centre d'Etudes de Vaujours, 93 - Sevran (France)). pp 135-139 of 3. Colloquium on Non-Destructive Testing Methods, 14-16 May 1974. Issy-les-Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French).

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

The precise measurement of x ray attenuation by a material shows up variations due to heterogeneities of composition or particle size. A monochromatic radiation source is used (obtained by exciting targets with a wide-spectrum x-ray beam). The attenuation measurements are carried out by two standard counting lines, one connected to a probe near the sample and the other to a probe placed behind the sample and measuring the beam intensity after attenuation. A calibration curve for a given material is plotted with a series of samples offering a density gradient around the normal average value, at an x-ray energy chosen as a function of the sample thickness. (FR)

29544 MULTI-TRANSDUCER SYSTEM TO DETECT AND ANALYZE ACOUSTIC EMISSION. Chretien, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services des Elements Combustibles et Structures). pp 11-of 3. Colloquium on Non-Destructive Testing Methods, 14-16 May

1974. Issy-les-Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French).

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

This study of a multi-transducer system concerns the choice of the elementary grid governing the positions of the transducers, the choice of the number of the transducers in the system and the definition of the analog data acquisition line. (FR)

29545 USE OF A RADIOELEMENT IN THE NONDESTRUCTIVE TESTING OF MULTI-PIN CONNECTION PLUGS. Vieillemaringe, P.; Dulac, P. (CEA Centre d'Etudes Scientifiques et Techniques d'Aquitaine, 33 – Le Barp (France)). pp 53-58 of 3. Colloquium on Non-Destructive Testing Methods, 14-16 May 1974. Issy-les-Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French).

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

A TU 10 probe is described. It uses a radioelement (metallic ^{170}Tm) and is strongly active in spite of its small size. In view of the thicknesses of materials tested, a good definition of the image is obtained with fairly short exposure times. (FR)

29546 APPLICATIONS OF INDUSTRIAL NEUTRON RADIOGRAPHY IN FRANCE. Qualitative and Quantitative Neutron Radiography. Bouloumie, J. P. (Centre National d'Etudes Spatiales, 31 – Toulouse (France)); Laporte, Andre (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). pp 93-100 of 3. Colloquium on Non-Destructive Testing Methods, 14-16 May 1974. Issy-les Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French).

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

The different applications of industrial neutron radiography are presented: in metallurgy and mechanics; for dimensional testing; for the analysis of a binary alloy; and in space pyrotechnics. (FR)

29547 THE NEUTRON RADIOGRAPHY. Application of the Solid Track Detectors (Kodak Film CA 80-15). Barbier, J. (Societe Kodak-Pathe, 75 – Paris (France)). pp 101-105 of 3. Colloquium on Non-Destructive Testing Methods, 14-16 May 1974. Issy-les-Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French).

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

The principles of neutron radiography are reviewed. The advantages presented by the solid track detectors used to collect the neutron radiographic image are discussed. The images are compared with those obtained by the conventional method involving silver halide radiographic films. (FR)

29548 AUTOMATIC DEVICE FOR TESTING WELDS ON THICK VESSELS. Roule, M.; Saglio, R.; Samoel, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service des Elements Combustibles et Structures). pp 6-10 of 3. Colloquium on Non-Destructive Testing Methods, 14-16 May 1974. Issy-les-Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French).

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

A completely automatic system was designed and developed to test linear or circular welds; sensitivity and accuracy were obtained by the use of focused transducers. (FR)

29549 A FAST PHASE-METER. Audenard, B.; Stach, C. (Societe Leanord, 59 – Lille (France)); Pigeon, M. (CEA, 75 – Paris (France)). (to CEA, 75 – Paris (France)). French Patent 2,194,971/A/. 3 Aug 1972. 15p. (In French).

The description relates to a fast phase-meter controlled by the phase and modulus of a defect signal to be analyzed. The defect-signal generated by an eddy current control apparatus and the reference signal provided by said apparatus are applied to a wave signal generator and to direction logic circuits the outputs of which are adapted to control the samplers associated with the wave signal generator and with a sign inverting circuit adapted to generate an analog signal representative of the sign of the phase shift; an analog gate blocks the output signal whenever the defect signal modulus is lower than a predetermined value. The invention can be applied to non-destructive control devices for detecting smaller and smaller defects in materials and in particular defects in tubes used in the nuclear field. (FR)

29550 A DEVICE FOR CONTROLLING ALARM SIGNALS ACCORDING TO THE MODULUS AND TO THE PHASE OF A PULSE. Audenard, B.; Stach, C. (Societe Leanord, 59 – Lille (France)); Pigeon, M. (CEA, 75 – Paris (France)). (to CEA, 75 – Paris (France)). French Patent 2,195,021/A/. 3 Aug 1972. 13p. (In French).

The description refers to a device for controlling alarm signals according to the modulus and to the phase of a defect signal provided by a non-destructive control apparatus, e.g. an eddy current control apparatus. The device comprises a phase-meters responsive to one period of the defect signal, a phase fast comparator, a circuit for detecting the first unbalance of the phase, a circuit for treating the defect signal modulus, a modulus fast comparator and at least one cell providing logic information respresentative of the defect, said information being applied to an AND-gate, the output of which is adapted to control an alarm device. The invention can be applied to the control of internal and external defects of materials, in particular in tubes used in the nuclear field. (FR)

29551 GENERAL REMARKS ON THE NON-DESTRUCTIVE TESTING OF WELDS. Colomer, J. (CEA Centre d'Etudes de Bruyeresle-Chatel, 92 – Montrouge (France)). Metaux (Corros.-Ind.); 49: No. 587, 283-294(Jul 1974. (In French).

From meeting on welding metallurgy; Marseille, France (8 Nov 1973).

Following some general remarks on nondestructive testing, the most suitable methods of weld inspection are reviewed with special reference to the physical phenomena on which they are based. The techniques mentioned are: methods based on the alteration of a flux by any flow in the weld (gas flux, neutron flux, electromagnetic waves, ultrasonics, electric and magnetic flux, thermal flux); mechanical stress methods based on the measurement of characteristic frequencies or on damping measurements; and test during welding either by the tracer method or by stress wave emission. (FR)

29552 RADIOGRAPHY WITH PROTONS. Cookson, J. A. (UKAEA Research Group, Harwell. Nuclear Physics Div.). Naturwissenschaften; 61: No. 5, 184-191(May 1974).

11 figs.; 22 refs.

Three quite separate ways in which protons may be used to produce radiographic information about the interior of specimens are described: marginal range radiography; multiple scattering radiography; and density profile and porosity measurement. Explanations of the physical principles and examples of the results are given for each technique. The sensitivity of the methods and their possible uses are discussed. (auth)

29553 DIGITAL DATA RECORDING SYSTEM FOR TENSILE STRENGTH EXPERIMENTS. Lehrmann, G. pp 141-152 of Reports from the Hot Cells. Karlsruhe, F.R. Germany; GfK (1974). (In German).

4 figs. Available from the Gesellschaft fuer Kernforschung.

Radioactive materials are investigated in a test equipment for tensile strength. In order to transmit the measured data obtained with the greatest accuracy, a digital data recording system is used. (TK/LH)

Nuclear Explosions

Refer also to abstracts 29032, 29608, and 29740.

29554 (AD-775820) STRATEGY FOR THE CONSTRUCTIVE EMPLOYMENT OF MILITARY FORCES IN SUPPORT OF PLOWSHARE OPERATIONS IN REMOTE AREAS. Student Essay. Kurtz, M. K. Jr. (Army War Coll., Carlisle Barracks, Pa. (USA)). 17 Mar 1972. 28p. NTIS $4.50.

The study examines whether or not there is a suitable peacetime role for the armed forces in support of nuclear construction operations under Project Plowshare. Following an analysis of opposing contemporary views of nation-building and domestic action, it is found that the role of military forces can be extended to incorporate nuclear construction projects in remote areas. A strategy includes joint and combined military-civil task forces equipped with nuclear explosives for use on selected projects, or for disaster relief. (auth)

29555 (AD-787735) SUITABILITY STUDY FOR SYSTEM-GENERATED ELECTROMAGNETIC PULSE SIMULATION. Final Report, January-December 1973. Higgins, D. F.; Wenaas, E. P.; De Plomb, E. P. (Computer Sciences Corp., Falls Church, Va. (USA)). Jun 1974. Contract F29601-72-C-0124. 91p. (CSC-T-4-P-108). NTIS $4.75.

The rationale employed in the selection of a suitable existing facility for (SGEMP) simulation is described. A high-quality SGEMP simulation chamber must satisfy certain requirements dictated by a comparison of the relevant physics of the simulated environment to those of the environment of interest. These requirements were established by the theoretical work reported in the appendixes. Two existing chambers are examined with respect to how well they might be modified to satisfy these requirements. It is concluded that the NASA-Lewis chamber pro-

vides some significant advantages over the Arnold Engineering Development Center candidate. (auth)

29556 (AD/A-000476) SEISMIC MASKING OF AN UNDERGROUND NUCLEAR EXPLOSION. Final Technical Report. Porter, L. D. (Northern Illinois Univ., Dekalb (USA)). 31 Oct 1973. 129p. (AFOSR-TR-74-1583). NTIS $5.75.

The accidental interference of a teleseism from an earthquake with the seismic signals from an underground nuclear explosion was examined by presenting a compilation of seismograms from thirty-two near-regional stations associated with the explosion. The explosion was detonated by the U.S. on August 14, 1969 at the Nevada Test Site. It had a yield of 3 kT (seismic estimate) and a depth of burial of 784 feet in alluvium. The interfering earthquake was a principal aftershock of a Kurile Island earthquake sequence, with a magnitude of 6.2 and a distance of 70 degrees from the explosion. The explosion waveform was embedded completely in the teleseismic p-wave at all near-regional stations. (auth)

29557 (AD/A-000628) SEISMIC EFFECT OF UNDERGROUND NUCLEAR EXPLOSIONS. Kuznetsov, A. A.; Baranov, A. O. 2 Oct 1974. Translated from pp 81-86 of Nauch Osnovy Sozdaniya Vysokoproizvodit, Rudikov, 1972. (FTD-HC-23-2613-74). 12p. NTIS $3.25.

Formulas used for determining the maximal seismic oscillation acceleration and velocity are presented. The calculations yield quite good approximations to actual measurements under full scale nuclear explosion conditions. The expected deformation of structures from seismic oscillations are also estimated. The seismic oscillation intensity in the nuclear explosion case is no higher than for explosions of conventional chemical explosives of the same power. (GRA)

29558 (AD/A-000951) EXTENDED ARRAY EVALUATION PROGRAM. Final Report, 1 April 1972–31 December 1973. Harley, T. W. (Texas Instruments, Inc., Dallas (USA)). 31 Jan 1974. Contract F33657-72-C-0725. 85p. NTIS $4.75.

Work performed on Contract F33657-72-C-0725 has been reported in detail in a series of seventeen special reports. This final report summarizes the material covered in each of the special reports and discusses the conclusions obtained. The seven tasks in the program included evaluation of the Alaskan long period array, the long-period Norwegian seismic array, the short-period Norwegian seismic array, and the stations of the very long period experiment. The remaining tasks included studies of network capabilities and analysis techniques, evaluation of two signal processing algorithms, and study of the considerations necessary to implement and operate a seismic surveillance network. (auth)

29559 (AD/A-001061) SOURCE THEORY FOR COMPLEX EARTHQUAKES. Blandford, R. R. (Teledyne Geotech, Alexandria, Va. (USA)). 10 Apr 1974. Contract F08606-74-C-0006. 102p. (SDAC-TR-74-4). NTIS $5.25.

Earthquake source theories of Haskell, Brune, Savage have been drawn upon to develop a description of an earthquake as a major slip accompanied by many smaller tensional and slip events. Natural explanations of several previously unexplained observations were found, such as robustness of the M_S: M_B discriminant; P corner frequency higher than S corner frequency; high-frequency P/S amplitude ratio higher than previous theories predict; increase of complexity as a function of third moment; small M_B relative to M_S for transform faults. The theory predicts that M_S: M_B populations of earthquakes and explosions will not converge at small magnitudes. (GRA)

29560 (AD/A-001099) OBSERVED RAYLEIGH WAVE GROUP VELOCITIES AND SPECTRAL AMPLITUDES FOR SOME EURASIAN PATHS. Technical Report No. 1. Lambert, D. G. (Texas Instruments, Inc., Dallas (USA)). 28 Feb 1974. Contract F08606-74-C-0033. 31p. (TI-ALEX-(01)-TR-74-01). NTIS $3.75.

Rayleigh wave group velocities were obtained for some Eurasian paths using VLPE data for events occurring during the International Seismological Month. Fundamental Rayleigh wave group velocities and spectra were determined using narrow band filters to minimize possible multipath and higher mode effects. Further, the spectra were corrected for geometrical spreading and effective attenuation. Observed Rayleigh wave group velocities for propagation paths crossing central India and the Russian and Siberian platforms were in close agreement to those observed for the central United States. The observed group velocities and amplitude spectra for paths in and normal to the Alpine-Himalayan fold system indicate the presence of thick crustal sections having high effective attenuation properties. (GRA)

29561 (EERL-TR-E-75-1) PROJECT LOST CREEK: FIELD TESTS OF MOUNDING AND CONTROLLED BLASTING. McAneny, C. C. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Jan 1975. 131p. Dep. NTIS $5.45.

A concept of blasting termed "mounding" involves using relatively compact explosive charges and breaking to the horizontal ground surface. Project Lost Creek comprised a group of single-charge and row-charge blasting experiments designed to investigate the concept of mounding. Mounding-row design criteria, fragmentation produced by mounding charges, and performance of mounding explosives with differing properties were studied, as were suitability of mounding for producing rock fill and use of controlled blasting in conjunction with mounding charges to diminish shock and to improve excavation slope control. (TFD)

29562 (LA-1025(Vol. 24)) WEAPON DATA EFFECTS AND INSTRUMENTS. Volume 24. Appendix 49. Mack, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 20 Aug 1947. 147p. Dep. NTIS $10.50.

A detailed description and analysis of the nuclear fireball produced from the Trinity Event are presented. Eighty-three photographs are included. The photographs are listed in the table of contents in tabular form, showing the viewpoint, the dimensional scale of the print, and the time for each. Among the prints are several composites, four stereo prints, and one color print. (TFD)

29563 (LA-5754-MS) PACER PROGRAM, FY-1974 LASL ACTIVITY. Shreffler, R. G.; Roush, R. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1974. Contract W-7405-ENG-36. 17p. Dep. NTIS $4.00.

PACER is a power program designed to meet the present energy crisis and the future world energy problem. The idea is to use clean, thermonuclear explosives to heat steam contained in a large underground cavity and to use the steam to operate a conventional electric power plant. The program is based upon a proposal made by R&D Associates to the AEC in October of 1972. As a consequence, the AEC funded the program in FY 74 for one-half million dollars with RDA as the prime contractor and LASL as the contract manager. The LASL effort during FY 74 is reported herein. RDA work is reviewed in other reports. (auth)

29564 (PB-237241) PLOWSHARE TECHNOLOGY ASSESSMENT: MEASUREMENT AND MONITORING. Bell, P. A.; Whan, G. A.; Busch, R. D. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Aug 1973. 46p. (NSF-RA/G-73-043). NTIS $3.75.

Sophisticated methods for measuring seismic motion, explosive yield, and possible radioactivity releases are required to assess the environmental effects of an underground nuclear explosion. The current state of the art of these methods for Plowshare Projects is described. Techniques for measuring and monitoring the effects of an underground nuclear explosion have been sufficiently developed to provide good predictions of possible damage to the environment. (GRA)

29565 (PB-237242) PLOWSHARE TECHNOLOGY ASSESSMENT: RADIOACTIVE CONTAMINATION. Johnson, P. G.; Bell, P. A.; Whan, G. A. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Sep 1973. 60p. (NSF-RA/G-73-044). NTIS $4.25.

Radioactive contamination has been a major concern of the general public in regard to industrial applications of nuclear explosives. A basic understanding of that subject is provided. Sources of radioactive contamination and predictions of the types and amounts produced are reviewed. The processes by which these radioactive materials might be distributed to the environment and the potential impacts on the environment are examined. (GRA)

29566 (PB-237270) PLOWSHARE TECHNOLOGY ASSESSMENT: THE NUCLEAR DEVICE. Bell, P. A.; Whan, G. A. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Oct 1973. 44p. (NSF-RA/G-73-045). NTIS $3.75.

Small, inexpensive, safe and reliable nuclear explosives will be required for the development of the commercial or industrial phase of plowshare technology. This report discusses these aspects of both fission and fusion explosives as well as the necessary requirements and procedures in a nuclear explosive fielding service. (GRA)

29567 (PNE-RB-66) PROJECT RIO BLANCO; SUMMARY OF RELATED HYDROLOGY PROGRAM TO SEPTEMBER 1974. Knutson, C. F. (CER Geonuclear Corp., Las Vegas, Nev. (USA)). 15 Jan 1975. 81p. Dep. NTIS $7.25.

Three underground nuclear explosions for the Rio Blanco Project, an investigation of nuclear stimulation of natural gas wells, occurred on May 17, 1973 in Colorado. A hydrologic pro-

gram was initiated to determine the effects of the explosions on water quality in the various aquifers in Rio Blanco area, the seismic effects on preexisting faults in the area and the movement of ground water in those faults, and the effects on water quality and flow in the springs and wells in the area. The test procedures and results are presented. (LCL)

29568 (STI/PUB-387) INTERNATIONAL TREATIES RELATING TO NUCLEAR CONTROL AND DISARMAMENT. Legal Series No. 9. (International Atomic Energy Agency, Vienna (Austria)). 1975. 87p. IAEA $5.00.

This publication presents, in one volume, the official English texts of the most important treaties relating to nuclear arms control and disarmament. The treaties reproduced are presented in chronological order. In the case of the Treaty on the Non-Proliferation of Nuclear Weapons, two documents containing provisions directly related to the terms of the Treaty are also reproduced. Although the Antarctic Treaty and the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies, deal with subjects of a rather special character, they are included, as they contain provisions relating to nuclear arms control and disarmament. (auth)

29569 (UCRL-76455) ELECTROMAGNETIC COMPUTER CODE DISSEMINATION AT LLL. Bevensee, R. M.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 6p. (CONF-741001-55). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

The electromagnetic computer code dissemination is an activity to expedite and promote work in the area of numerical data analysis of electromagnetic radiation and propagation problems, particularly those important in electromagnetic pulse (EMP) effects. The dissemination involves a number of activities: (1) collection of relevant computer codes from both foreign and domestic sources, (2) creation of new codes by ESR Group personnel when required for Group problems, (3) modification by the ESR group of "imported" codes for additional capability, (4) adaptation of all codes to the CDC computers at LLL to verify their operation with test cases, (5) announcement and description of all unclassified codes ready for distribution to the public in an Electromagnetic Computer Code Newsletter, published about every six months, (6) mailing of software material such as user's manuals, reports, listings, card decks, and tapes to requesters, and (7) offering a limited amount of debug advice when requested. (auth)

29570 (USGS-474-204) EXPLOSION-INDUCED FRACTURES OF SELECTED ANNOUNCED UNDERGROUND NUCLEAR TESTS, YUCCA FLAT, NEVADA TEST SITE, NEVADA, JANUARY–DECEMBER 1973. Snyder, R. P. (Geological Survey, Denver, Colo. (USA)). 1973. Contract AT(29-2)-474. 65p. Dep. NTIS $5.45.

During the period January-December 1973 personnel of the U. S. Geological Survey mapped the surface effects produced by four underground nuclear tests conducted in Areas 2, 3, and 7, Yucca Flat, Nevada Test Site. Three tests resulted in collapse sinks and mappable surface effects. Faults as well as fractures on which previous explosion-induced movement had been noted were reactivated by some tests. One test had neither surface fractures nor collapse features. (auth)

29571 GEOLOGICAL FACTORS IN RAPID EXCAVATION. Pincus, H. (ed.). Engineering Geology Case History Number 9. Boulder, CO; Geological Society of America, Inc. (1972). 85p. $4.50.

Seven papers are presented on the influence of geological factors on excavation techniques and on the role of engineering geologists in rapid excavation projects. A separate abstract was prepared for one paper. The remaining 6 papers on non-nuclear excavation methods were not in scope for NSA. (LCL)

For an abstract of an individual paper see: 29572.

29572 GEOLOGIC FACTORS IN RAPID EXCAVATION WITH NUCLEAR EXPLOSIVES. Hamburger, R. (Atomic Energy Commission, Washington, DC). pp 17-25 of Geological Factors in Rapid Excavation. Pincus, H. (ed.). Boulder, CO; Geological Society of America, Inc. (1972).

Many of the essential elements required to design safe nuclear excavation projects are geologic. Excavation dimensions depend on such rock properties as compressibility, porosity, water content, and strength. Estimates of ground motion at locations of natural or manmade structures depend on knowing the geology of the explosion site, the transmission path, and the structure site. The hydrologic environment must be understood in order to avoid unwanted effects. Although computational techniques have been developed to design nuclear excavations, the results of such calculations are greatly dependent on how well the geologic data provided represent the actual conditions. Better techniques to determine rock properties are required. (auth)

Protective Structures and Equipment

Refer also to abstracts 29406 and 29616.

29573 (AD-783061) SLANTING FOR COMBINED NUCLEAR WEAPONS EFFECTS: EXAMPLES WITH ESTIMATES, AND AIR BLAST ROOM FILLING. Technical Report Summary. Murphy, H. L.; Beck, J. E. (Stanford Research Inst., Menlo Park, Calif. (USA). Facilities and Housing Research Dept.). Jun 1973. Contract DAHC20-71-C-0292. 228p. NTIS $6.00.

The report provides updated and expanded versions of, and thus replacements for, Chapter 8 (AD-734 831) (Slanting the Building) and Appendix E (AD-734 832) (Room Filling from Air Blast) in the latest of a series of feasibility studies on slanting (design modification) of basements in new buildings, to provide shelter against combined nuclear weapons effects, e.g., air blast and initial nuclear, thermal and fallout radiation. As in the overall feasibility study, the two parts of this report were written solely for the guidance of building design professionals (architects and engineers). Full slanted basement shelters, as presented in these reports, more than meet requirements for protection against all natural disasters except floods, even those designed for as low as 5 or 10 psi air blast overpressure and related radiation effects. (auth)

29574 (AD/A-000419) AIRCRAFT PENETRATION OF CLOUDS GENERATED BY NUCLEAR BURSTS. Final Report, July 1972–December 1973. Patrick, R. P.; Arnett, G. D.; Yingling, W. A. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Sep 1974. 280p. (AFWL-TR-73-82). NTIS $8.75.

Aircraft penetrating radioactive dust clouds are exposed to an environment which could prove to be mission crippling. The performances of the crew of the aircraft, the mission critical electronics equipment, and/or the engines could be degraded sufficiently to compromise the mission completion capability of the aircraft. A detailed examination of the hazards associated with cloud penetrations has been performed. It was found that the major hazards to the crew consist of the ionizing doses and dose rates from being surrounded by the radioactive cloud and from dust which accumulates in the cockpit during penetration, and the radiation burns of skin in direct contact with the dust. The major hazard to electronics equipment is due to the dose accumulated from dust accumulated in the plenum chambers of black boxes which are cooled by an open cycle process. It is shown that significant protection can be provided for the crew and avionics equipment by the installation of filters. General techniques are presented for selecting filter design criteria for the crew and equipment environment control systems. (auth)

29575 (LA-5894-PR) VENTILATION SYSTEMS ANALYSIS DURING TORNADO CONDITIONS, JULY THROUGH DECEMBER 1974. Gregory, W. S.; Bennett, G. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1975. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

A review of several facility ventilation systems is essentially complete. The types of facilities reviewed include plutonium reprocessing and fabrication plants as well as reactors and research facilities. The purpose of this review was to identify the complexity and types of systems involved. In addition, typical ventilation system components were identified. The principal result of this review was the identification of several basic models which are common to all of the systems reviewed. A literature search for pressure-flow data reveals a large amount of data for normal ventilation flow but very little for high flow rates. Identification of the experimental data required and relative priority of component testing is complete. Several Architect-Engineering firms have been contacted to determine if a computer code to analyze ventilation systems would be useful to them and what type of computing hardware do they have at their disposal. A basic formulation for the dynamic response of a simple system has been developed. A "lumped-parameter" assumption for the fluid dynamics portion of the problem coupled with an isothermal assumption for the thermodynamics is the basis for this initial formulation. A simple system consisting of valves or dampers, filters, fan and cell or building volumes has been analyzed. The response of this system to tornado depressurization transients at both the supply and exhaust is presented in graphical form. In addition, a computer movie has been developed which presents the pressure and flow data for the system. (auth)

29576 GENERAL SAFETY STANDARD FOR INSTALLATIONS USING NON-MEDICAL X-RAY AND SEALED GAMMA-RAY SOURCES, ENERGIES UP TO 10 MeV. NBS Handbook 114. Washington, DC; National Bureau of Standards (1975). 68p. (ANSI-N-543-1974). GPO $0.90.

This standard establishes requirements for the design and operation of common types of installations which use gamma and x radiation for non-medical purposes. Its objective is to protect persons who work with or are near such installations, as well as the general public, against excessive exposure to radiation. Maximum permissible dose limits established by the National Council on Radiation Protection and Measurements are cited. Methods for achieving adequate radiation protection are described, including structural details, surveys and inspections, and operating procedures. Appendixes contain technical information useful for design of radiation shielding barriers. (auth)

29577 RESEARCH OF THE LOWEST COST WHEN SPECIFYING A HIGH EFFICIENCY AIR FILTERS INSTALLATION. Billard, F. (Air Industrie, 92 – Courbevoie (France)); Seau, C. (CEA Centre de Marcoule, 30 – Bagnols-sur-Ceze (France)). pp 401-418 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28–31 May 1974. Jarry, H. (Ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The decision to equip industrial premises or hospitals with high efficiency air filters agrees with a safety aim for technical or sanitary reason. The choice of the airflow to be treated and the efficiency of the filtration results directly from this purpose. These initial conditions being given, it is suitable then to define the other characteristics of the installation, especially the filtering area and the total pressure drop including the dust holding capacity so that the cost will be minimal. A calculation system of the installation is shown taking into consideration the investment cost and the operating cost. An example points out that there is an economical optimum corresponding to values of filtering areas and total pressure drop different enough from that regularly used for the latest installations. Some existing installations are considered and it is shown how the application of the same principles has considerably reduced the operating costs of the very large air filtration installations at the "Centre de Production de Plutonium de Marcoule," by effecting modifications elementary but very attractive for reduction of expenses. In conclusion, the attention of future users of filters is drawn to try to obtain better conditions for their installations and to specify these conditions in their request to suppliers. (FR)

29578 DEFECTIVE CONTAINMENTS OBSERVED IN HIGH-ACTIVITY LABORATORIES WHICH NEVERTHELESS REPLY IN AN OVER-ALL WAY TO THE GENERAL RECOMMENDATIONS LAID DOWN FOR FACILITIES OF THIS TYPE. Bouin, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Protection Contre les Rayonnements). pp 525-538 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (Ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

National and international recommendations have been laid down in order to limit the spread of contamination in the event of accident and to protect as far as possible those present at the time. It is advised in particular to divide the laboratories into zones isolated from one another by a reduced-pressure gradient increasing as the risks. To cut down the atmospheric radioactivity concentration, a series of air renewal rates is also stipulated. The purpose of this report is to attract attention by means of accidents having occurred at the CEN-Saclay, to faulty containments which can arise accidentally between zones even when the laboratories answer to the recommendations as a whole and the ventilation systems works normally. (FR)

29579 ABSOLUTE GLOVEBOX VENTILATION FILTRATION SYSTEM WITH UNIQUE FILTER REPLACEMENT FEATURE. Freeman, S. S.; Slusher, W. A. (Mound Lab., Miamisburg, Ohio (USA)). pp 193-205 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28–31 May 1974. Jarry, H. (Ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

A glovebox ventilation system was designed for a new plutonium-238 processing facility that provided: downdraft ventilation; a leak tight seal around the high efficiency particulate air filters (HEPA); and a method for changing the filters internally without risk of contaminating the laboratory. A 6.25 in. dia tube, long enough to contain two HEPA filters in series, is welded to the bottom of the glovebox for the exhaust. A similar 6.25 in. dia tube is welded to the upper back panel of the glovebox for supply air. The locations of the supply and exhaust tubes provide the downdraft flow required. A double-lipped gasket made of low durometer silicone rubber attached to the top of each filter is designed to provide a helium leak tight seal with the exhaust tube even with imperfect tubes. A flanged opening to the exhaust tube is provided at the back of the glovebox. The filter change is made by inserting a new filter through this opening into the exhaust tube. As this new filter is pushed forward, the first filter which has accumulated the airborne particulates is ejected into the glovebox, the second filter moves into the top position, and the new filter becomes the second filter in series. This glovebox ventilation filtration system has operated successfully for five years. (FR)

Safety Engineering

Refer also to abstract 29393.

Vacuum Engineering

Refer also to abstract 30401.

ENVIRONMENTAL AND EARTH SCIENCES

Refer also to abstract 32363.

Minerals and Ores

Refer also to abstract 32237.

29580 (CEA-CONF-2812) VENTILATION OF URANIUM MINES. Francois, Y.; Pradel, J.; Zettwoog, P.; Dumas, M. (CEA Centre d'Etudes Nucleaires de Fontenay-Aux-Roses, 92 (France)). 1973. 51p. (In French). (CONF-7309134-1). Dep. NTIS (US Sales Only) $5.75.

From panel on radon in uranium mining; Washington, District of Columbia, USA (4 Sep 1973).

After a brief review of the French legislation on the ventilation of U mines, the techniques and devices used for the primary ventilation in supplying air and removing noxious gases to the various levels, and the secondary ventilation assuring the distribution of the primary air or the ventilation of exploratory galleries and culs de sac are described. The materials used and the installed power are discussed. The air outputs required per man and per level are evaluated. The difficulties found in ventilating different types of workings are discussed. The computer calculations of the primary ventilation networks are described. (JSR)

29581 (INIS-mf-1551, pp 13-38) DISCOVERY OF A PREHISTORIC NUCLEAR REACTOR IN THE REPUBLIC OF GABON. Lectures, Autumn 1973–Spring 1974. Vendryes, G. (CEA, Paris). Jun 1974.

A detailed account is given of the discovery in Gabon of natural deposits of uranium ore depleted down to as low as 0.347 at. %. These ores contained very high concentrations of uranium, and studies of the isotopic composition of neodymium present in the sample were consistent with a natural self-sustained chain reaction of fissions having taken place about $1.7-2.10^9$ years ago. The neutron flux appears to have been much less than 10^9 n/cm^{2}s and the duration much longer than 30,000 years. Altogether about 4000 MW years of thermal energy seems to have been released, with a heat production of about 10^{15} joules/m^3 of "core." A possible geological explanation of the process by which this unusual phenomenon may have occurred is given. (INIS)

29582 (RLO-2227-T12-52) RELATION BETWEEN NATURAL RADIOACTIVITY IN SEDIMENT AND POTENTIAL HEAVY MINERAL ENRICHMENT ON THE WASHINGTON CONTINENTAL SHELF. Scheidt, R. C. (Oregon State Univ., Corvallis (USA). Dept. of Oceanography). Jun 1975. Contract AT(45-1)-2227. 75p. Dep. NTIS $6.75.

Thesis.

Natural radionuclides may be indicators for dense mineral placers along marine shorelines. Relict beach and river deposits occur in continental shelf sediments. These deposits result from the reworking of beach sands by wave action during the Holocene Transgression. Some dense, resistant minerals associated with placer deposits are known to contain ^{238}U and ^{232}Th activities. Shelf sediments, enriched in heavy minerals, might be expected to be high in these natural radioactivities. The usefulness of natural radioactivity to locate and to map dense mineral deposits was therefore explored and relations between natural radioactivity in marine sediments and dense mineral content on the Washington Continental Shelf were established. High ^{40}K activity in sediments was positively correlated significantly with high mud content. High ^{230}Th and ^{232}Th activities were associated with fine, well-sorted sands and correlated very highly with the weight percent total heavy mineral sands in the sediment. These relations distinguish depositional environments as high in ^{40}K content and erosional environments as high in ^{230}Th and ^{232}Th content. Two areas of enrichment were found by radiometric mapping and by mineral analyses. Off Destruction Island, Washington, maximum ^{230}Th and ^{232}Th activities were found in 30 m water depth. Activity distribution and mineral enrichment were consistent with general northward transport of nearshore sediment. In 33 m water depth off Clatsop Spit, Oregon, the second enrichment area was found. The ^{232}Th/^{230}Th activity ratios are different for these two areas. Probably the heavy minerals in these two areas are from different sources. (auth)

29583 (RME-118) GEOLOGY OF THE URANIUM DEPOSITS OF THE LUKACHUKAI MOUNTAINS, APACHE COUNTY, ARIZONA. Nestler, R. K.; Chenoweth, W. L. (USAEC Grand Junction Office, Colo. Production Evaluation Div.). Sep 1958. 73p. GJO.

In a study of the comparative importance of sedimentary and tectonic ore controls and in search of data bearing on the origin of the uranium deposits, ten mines in the Lukachukai Mountains, Apache County, Arizona were examined in detail. All commercial deposits in the area are in the Salt Wash Member of the Morrison Formation of Jurassic age. The ore bodies are elongate and horizontally lenticular in shape and consist of one or more ore pockets surrounded or separated by protore. The composite length of ore bodies consisting of two or more ore pockets separated by subore grade material ranges up to 1,100 feet; individual ore pockets range up to 350 feet in length. Elongation is usually at least three times the width and is parallel to paleostream depositional trends measured in and near the ore bodies. Claystone and/or siltstone units nearly always underlie and frequently overlie the host sandstone units. Ore occurs most frequently in trough-type, cross-stratified sandstone which fills scours and channels in the underlying claystone units. Lithofacies maps and mine mapping show that ore bodies are restricted to areas of rapid lateral color change which in general are also areas of rapid change in the ratio of mudstone to sandstone. Most ore bodies are located on the southwest flank of the Chuska syncline within a broad belt which trends nearly north-south across the southeast end of the Lukachukai Mountains. It is suggested that a set of shear joints served as vertical channelways for the distribution of migrating uraniferous ground water. Location of the ore belt is apparently controlled by the intersection of these shear joints and particularly favorable facies of the Salt Wash Member. (auth)

29584 (RMO-827) EXPLORATION DRILLING IN THE BLANDING DISTRICT, SAN JUAN COUNTY, UTAH. (USAEC Grand Junction Office, Colo.). [nd]. AT(30-1)-761. 26p. GJO.

The Blanding exploration program was conducted by the Atomic Energy Commission in the Cottonwood mining district, San Juan County, Utah. The area withdrawn from mineral entry covers forty-three square miles. The Atomic Energy Commission exploration programs included two diamond drilling projects, a limited wagon drilling project, and an airborne radioactivity survey in 1950 and 1951. Radioactivity hole logging equipment was utilized on the second drilling project to aid in the evaluation of the airborne survey and later in the development of ore finding criteria. Ore occurrences, mineralogy, ore guides, mining, and mapping are discussed. Operations have begun at five new mines as a result of the Atomic Energy Commission exploration program. (auth)

29585 (TM-22) SOME OBSERVATIONS ON THE CHINLE FORMATION OF ARIZONA. Leonard, J. H. (USAEC Grand Junction Office, Colo.). 10 Nov 1952. 4p. GJO.

Uranium ore deposits observed are just above a blue shale of the Chinle and have a cobalt zone above the uranium zone. The colors, at a distance, appear to be a brownish stain above a blue shale. While every deposit showed these colors, some areas with these colors did not contain uranium. It is postulated that the lower member of the Chinle formation might have been a lake bed and that the strata were deposited by the feeder streams running into the lake. (MCG)

29586 (TM-186) GEOLOGIC DRILLING IN THE NORTHWEST CARRIZO AREA, APACHE COUNTY, ARIZONA. Chenoweth, W. L. (USAEC Grand Junction Office, Colo.). 1 Mar 1956. 12p. GJO.

A total of 1893.7 feet of core drilling was done in 18 holes in the Northwest Carrizo area for structural and stratigraphic information. Results indicate that a shallow syncline, obscured locally by a mantle of dune sand, exists between Toh Atin anticline and an east plunging anticline to the north. No relation was noted between the structure and uranium mineralization. A geologic map of the Dinne Mesa NE quadrangle, Arizona–Utah and a lithologic log of diamond drill hole S-701 in the quadrangle are included. (MCG)

29587 (TM-D-1-14) STUDY OF CONCRETIONS AS APPLIED TO THE GEOLOGY OF URANIUM DEPOSITS. Meschter, D. Y. (USAEC Grand Junction Office, Colo.). Feb 1958. 18p. GJO.

Calcareous concretions are common in terrestrial sandstone formations that range in age from Cretaceous through Tertiary in Wyoming, Nebraska, and South Dakota. They are found with some uranium deposits. Concretions in the Monument Hill Area Southern Powder River Basin, Converse County, Wyoming, may be classified on the basis of physical form as sheetlike, tubular, spheroidal, or "cannon-ball". There are modifications, combinations, and irregular variations of these classes. More than 1300 individual

observations of concretions were made. Well-formed concretions and some groups of concretions have definable trends of elongation. Criteria for determining concretion orientations and the use of such orientations for studying the pattern of ground water flow, with reference to the geology of uranium deposits, are described. Orientation trends form local and regional patterns correlatable with broad geologic structures. Concretions are believed to have their origin in migrating ground waters, and the orientation patterns appear to reflect the pattern of movement of these waters. (auth)

29588 RADIOACTIVE ELEMENTS IN SEDIMENTARY ROCKS OF THE YENISEI RIDGE, CHINGASAN SERIES. Gavrilenko, V. A. (Tomsk Polytechnical Inst., USSR). Geokhimiya; No. 1, 81-91 (Jan 1975). (In Russian).

Data on the peculiarities of radioactive element distribution in carbonate-terrigenous deposits of the Chingasan series of the late Pre-Cambrian are given. The dependence of radioactive element concentrations on cyclic recurrence of sedimentation is shown. The largest amounts of radioactive elements is confined to deposits having formed after a prolonged continental interval and during the maximal transgression of the sea and the minimal amounts of radioactive elements is confined to deposits formed under conditions of the regressing sea. (auth)

29589 ENERGY, METALS AND ORES IN FRANCE IN 1973. A6 – Uranium. Ann. Mines; No. 8, 26-27(Aug 1974). (In French).

The French uranium production (in France and in Africa) is presented. (FR)

29590 URANIUM SUPPLY AND PRICES. Nucleonics Week Special Report. New York; McGraw-Hill, Inc. (1974). 38p.

A compilation of articles carried in 1974 in Nucleonics Week is presented. (MCG)

29591 AUSTRALIA'S MINERAL WEALTH. Coghill, I. Melbourne; Sorrett Publishing Pty. Ltd. (1971). 207p.

An account is given of the exploration and prospecting that led to the discovery of Australia's uranium deposits. Present uranium reserves are discussed with regard to current and future world demand. (AT)

29592 STATE OF URANIUM INDUSTRY IN AUSTRALIA. Com. Naz. Energ. Nucl., Notiz.; 20: No. 12, 49-51(Dec 1974). (In Italian).

A review of the situation prevailing in the uranium sector in Australia, with special reference to industry-government polemics and to the uranium industry's activities in the Northern Territory. (auth)

29593 INCORPORATION OF URANIUM IN MODERN CORALS. Amiel, A. J.; Miller, D. S.; Friedman, G. M. (Rensselaer Polytechnic Inst., Troy, NY). Sedimentology; 20: 523-528(1973).

Uranium occurs in corals at three sites: in organic matter; adsorbed on the surfaces of skeletal aragonite; and in the aragonite lattice. Organic matter incorporates from sea water by chelation 40 to 70 ppM uranium; skeletal aragonite incorporates only 3 ppM. However, as the organic fraction is low (0.1%), its high concentration of uranium does not significantly affect the total concentration of uranium in the coral. A negligible concentration of uranium, 40 to 60 ppB, is adsorbed on skeletal aragonite from which it is readily leached or exchanged. This low concentration of adsorbed uranium (<2% of the total uranium in skeletal aragonite) is related to the very small specific surface area (1.5–1.8 m^2/g) of the corals. (auth)

29594 EFFECT OF GEOLOGICAL FACTORS ON STOPE-AND-PILLAR LAYOUT IN AN ELLIOT LAKE URANIUM MINE. Hedley, D. G. F. (Dept. of Energy, Mines, and Resources, Elliot Lake, Ont.). CIM (Can. Mining Met.) Bull.; 68: No. 755, 107-112 (Mar 1975).

The sedimentary uranium deposits at Elliot Lake are fairly regular and a uniform pattern of mining would be expected; however, only 26% of the 86 completed stopes examined conformed to the standard layout of stopes and pillars. The reasons for changes in stope-and-pillar layout were obtained by visual inspection and questioning of mining personnel. Sixty-six per cent of the stopes were affected by geological factors, which were subdivided into dip of orebody (12%), ground conditions (9%) and faulting (45%). The major factor affecting stope-and-pillar layout is faulting, with east–west-trending faults which cut across the stopes having the greatest effect. General guidelines which evolved from the investigation are that: (a) faults with less than 4-ft vertical displacement have little or no effect on stope layout; (b) faults with a 4- to 15-ft vertical displacement require extra pillar support and reduced stope spans; and (c) faults with more than 15-ft vertical displacement curtail mining in a stope. The roof horizon in the stopes is affected by the presence of bedding-plane slips in the immediate roof strata. In the area examined, 21% of the roof had been mined to a bedding-plane slip. Also, bedding-plane slips are the major cause (56%) of the roof being mined 1 to 2 ft above the hanging-wall contact and the predominant cause (87%) of the roof being mined over 2 ft above the hanging wall. It is estimated that when a bedding-plane slip exists within 2 ft of the hanging wall there is a 35% probability that the roof will be taken down to this slip plane whereas if the slip plane is more than 2 ft above the hanging wall there is only a 5% probability. (auth)

29595 URANIUM AND THORIUM IN POTASH-RICH RHYOLITES FROM WESTERN BAHIA (BRAZIL). Sighinolfi, G. P.; Sakai, T. (Federal Univ. of Bahia, Brazil). Chem. Geol.; 14: No. 1, 23-30(Oct 1974).

The U and Th distribution in K-rich acid metavolcanics affected by postmagmatic processes was studied. Th (20 ppM) and U (2.41 ppM) average abundances are well within the normal ranges for granitic rocks, but the Th/U values are appreciably higher than most of the values reported. Since the rhyolitic magma is supposed to have been formed by partial melting of pre-existing rocks, the high Th/U ratios may be due: (1) to an extreme magmatic fractionation towards a K-rich trend in the magma chamber or during magma displacement; and (2) to high Th/U ratios in the original material, probably ancient crystalline basemental rocks depleted in U with respect to Th during previous cycles. The possible influence of postmagmatic processes on U and Th distribution is discussed, and evidence of U mobilization and redistribution within the formation is set forth. (NL)

29596 ACCUMULATION OF URANIUM IN SEDIMENTS AND PHOSPHORITES ON THE SOUTH WEST AFRICAN SHELF. Veeh, H. H. (Flinders Univ. of South Australia, Bedford Park); Calvert, S. E.; Price, N. B. Mar. Chem. (Amsterdam); 2: No. 3, 189-202(Nov 1974).

Organic-rich sediments and coexisting phosphorites from the continental shelf off South West Africa were analyzed for uranium and thorium by alpha spectrometry. The uranium concentrations in the sediments range from 10 to 55 ppM, with an isotopic composition close to that of seawater, indicating that uranium is passing into the sediments at the present time. The phosphorites occur in the sediments as thin unconsolidated laminae and as lithified nodules and pellets, with uranium contents ranging from 79 to 158 ppM. Based on the uranium isotopic composition, only the unconsolidated phosphorite laminae are recent, while the lithified nodules and pellets, with $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ ratios close to radioactive equilibrium, appear to be inherited from a previous period of phosphorite deposition. Deposition of uranium appears to take place predominantly by incorporation into fluorapatite growing authigenically within the sediment. Uranium accumulation rates, computed from ^{14}C-dated sections of the sediment cores, and using only uranium values with modern isotopic composition, range from 232 to 765 $\mu g/cm^2$ per 1,000 years. These results stress the importance of organic-rich sediments containing authigenic phosphorite beneath areas of high organic productivity as a major sink for uranium in the ocean. (NL)

29597 POSTDEPOSITIONAL INJECTIONS OF URANIUM-RICH SOLUTIONS INTO EAST PACIFIC RISE SEDIMENTS. Rydell, H.; Kraemer, T.; Bostroem, K.; Joensuu, O. (Univ. of Miami, Coral Gables, FL). Mar. Geol.; 17: No. 3, 151-164 (Oct 1974).

An 8.5 m long apparently undisturbed core from a hilltop on the crest of the East Pacific Rise has uranium and thorium isotope distributions that are very unusual. The core is very poor in ^{232}Th, and very rich in U, particularly at the 500-cm level, where a value of about 150 ppM is reached. At the same depth the $^{230}Th_{xs}$ reaches very large negative values. These facts could be accounted for if one assumes that solutions rich in U and poor in Th had been postdepositionally injected into the sediments about 90,000-110,000 years ago. The top of the sediment received much of its U from seawater, judging from the $^{234}U/^{238}U$ ratio. Possibly carbonate rich solutions were the carriers of the injected uranium. (NL)

Radioactive Effluents

Refer also to abstracts 29174, 29203, 29649, 29650, 29651, 29653, 32220, and 32357.

29598 (SCP-2.28.01-4) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT: MAIN REPORT. Prospective Site: Naverfjorden (Brunlanes). Killerud, K.; Tveten, U. (Scandpower A/S, Oslo (Norway)). 29 Jul 1974. 77p. (In Norwegian). Dep. NTIS (US Sales Only) $7.00.

Atmospheric dispersion was calculated on the basis of meteorological data for the Naverfjorden (Brunlanes) proposed nuclear power plant site on the Oslofjord. Data on releases of radioactive materials from both BWR and PWR type reactors under normal operation and following loss of coolant accidents (two for each reactor type, corresponding to different assumptions of conditions following the accident) together with population data were used to calculate the resulting radiation doses to human populations. (NO)

29599 (SCP-2,28,01-7) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT: SUPPLEMENTARY REPORT, CALCULATION BASES AND MODELS. Killerud, K.; Tveten, U. (Scandpower A/S, Oslo (Norway)). 30 Sep 1974. 51p. (In Norwegian). Dep. NTIS (US Sales Only) $5.75.

Following general introductory sections, the release of radioactive materials to the atmosphere during normal operations of nuclear power plants is discussed on the basis of origin, nature, and treatment, and of the station parameters. The postulated loss of coolant accident and its development are then defined and discussed and the influence of the characteristics of the reactor considered. The computational models for dispersion and radiation dose calculations are then discussed and the mathematical basis for the RADOS code version used for whole-body dose calculations for the human population is presented. Thyroid doses are calculated using the CONC code which is also briefly described. Pasquill-Gifford's dispersion parameters, or a close approximation to them, are used. (NO)

29600 RADIOLOGICAL EXPOSURE IN THE UPPER RHINE AREA BY NUCLEAR FACILITIES. Bayer, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). KFK Nachr.; 6: No. 3, 17-25(1974). (In German).

7 figs.; 2 tabs.; 10 refs.

Based on the HERMES code and on the Mississippi study, the radiological exposures due to ^{3}H, ^{85}Kr, ^{131}I, and ^{133}Xe, which are involved with the nuclear power to be expected up to 1985 in this region, were estimated and compared in a forecasting study with the remaining radiological exposures. (GE)

29601 CALCULATION OF THE EXTERNAL GAMMA DOSE FROM RADIOACTIVE GASEOUS EFFLUENTS. Allen, J.; Abbey, F. (UKAEA Safety and Reliability Directorate, Culcheth). pp 623-649 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (Ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Design and operational limits for the release of radioactive gaseous effluents from nuclear facilities depend on the resultant radiation exposure of occupants of the facility and the surrounding population. One aspect of this problem is the external whole-body gamma dose received by individuals both inside and outside the effluent plume. Accurate evaluation of the dose levels is complicated by geometric and other complexities. A computer program PLUDOS, written to enable the necessary calculations to be performed, is described. Some typical results are also discussed. PLUDOS calculates the ground level dose rate from a continuous release of gaseous activity from a ground level or elevated point source. This calculation will also give the integrated dose resulting from a short-term release. The program represents the effluent plume by a group of line sources of activity radiating from the point of release, the strength of the line sources being weighted according to the cross-wind and vertical distribution of activity in the plume. To allow for the fact that the plume may not be truly conical the geometry can be changed with downwind distance at which the dose is calculated. Radioactive decay is represented by an exponential reduction of line source strength with distance from the point of release. Attenuation and dose-rate build-up factors due to the air are also considered. The dose rates are obtained at several distances from the point of release. They may be limited to the downwind direction or may be obtained at a number of different angular positions relative to the wind direction. In the latter case the mean value of the dose rate over all directions is also calculated to give information on long term continuous releases for which the wind direction may vary. (FR)

Radioactivity Monitoring and Transport

Refer also to abstracts 29564, 29565, and 29567.

29602 (BNWL-B-336) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR CY-1973. Nees, W. L.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-1830. 71p. Dep. NTIS $5.45.

Data are presented on the radioactivity in environmental samples collected from various locations within the Hanford plant boundaries during 1973. Measurements were made of the content of ^{90}Sr and total α activity in Columbia River water samples; ^{131}I and total α activity in samples of surface air; Pu, ^{90}Sr, ^{95}Zr, and ^{95}Nb content in soil and vegetation samples; radioactive particles on Hanford roadways; and radioactivity from radionuclides in gamebirds and wild mammals sampled on or near waste sites. The total-body external radiation dose to personnel was estimated to be 8 mrem on the basis of periodic measurements of exposure rates at various locations. (CH)

29603 (CONF-750503-3) COMPARISON OF ENVIRONMENTALLY RELEASED RECYCLE URANIUM-233 HTGR FUEL AND LMFBR PLUTONIUM FUEL. Till, J. E. (Oak Ridge National Lab., Tenn. (USA)). 1975. 21p. Dep. NTIS $4.00.

From 4th national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

Uranium-233 is bred from ^{232}Th in High Temperature Gas-Cooled Reactors (HTGR), separated during reprocessing, and recycled to compose approximately 37% of the new fuel elements. This recycled ^{233}U contains up to 1200 ppm ^{232}U which is a very radiotoxic isotope of uranium, having a relatively high specific activity (21.4 Ci/g), and accounting for 82.1% of the total activity. The use of ^{233}U fuel in the projected HTGR economy requires an analysis of its radiological implications. Assuming equal masses of each are released to the environment, a comparison was made of recycled ^{233}U HTGR fuel and Liquid Metal Fast Breeder Reactor (LMFBR) plutonium fuel considering atmospheric, aquatic, and terrestrial transport, and impact on man and other biota. The study revealed that LMFBR plutonium fuel is 500 times more radiotoxic to man if inhalation is the exposure pathway; however, exposure via ingestion of contaminated water or vegetation yields uranium/plutonium fuel dose ratios to the bone and total-body of 0.4 and 1.2 respectively. Radiological insult from HTGR uranium to aquatic plants, invertebrates, fish, and terrestrial animals dependent on aquatic food supplies was 25% to 65% of that from LMFBR plutonium. Uranium-232 contributes up to 90% of the total ^{233}U fuel dose although it is only approximately 0.1% of the mass. It is concluded that once released to the terrestrial and aquatic environments, recycled ^{233}U HTGR fuel and LMFBR plutonium fuel appear to be of nearly equal radiotoxicity, and additional research is needed to further evaluate the potential radiological and ecological impact of this new type of uranium fuel. (auth)

29604 (COO-2450-1) IODINE-129: A STUDY OF ITS TRANSPORT IN THE ENVIRONMENT AND DISTRIBUTION IN BIOLOGICAL SYSTEMS. Annual Progress Report, June 1, 1974-May 31, 1975. Manuel, O. K.; Nicholson, L. M. (Missouri Univ., Rolla (USA). Dept. of Chemistry). 1975. Contract AT(11-1)-2450. 35p. Dep. NTIS $4.75.

During the first year's work a great deal of the efforts were devoted to the development of reliable analytical techniques for measuring and extracting iodine from various samples. Major accomplishments during this first year are as follows: i) Several sets of interlaboratory standards were prepared. Each set consists of one biological standard of modern porcine thyroid powder and 10 samples selected from three different inorganic standards of basic KI with $^{129}I/^{127}I \approx 10^{-3}$, 10^{-5}, and 10^{-7}. ii) A radiochemical laboratory has been made available to us on a continual basis at the reactor facility at Columbia, Missouri. The laboratory has been set up and is used for the post-irradiation chemistry. iii) Total iodine and ^{129}I were measured in 17 modern bovine thyroids, in five modern cervine thyroids, in one subsurface brine, in one sample of equine thyroid powder prepared in 1947, in one sample of modern porcine thyroid powder, and in four inorganic standards. iv) Samples of soil and plants were collected and analyzed radiochemically for ^{127}I, and samples of aerosols are currently being collected. Tests made on a small-sized quartz combustion apparatus showed the utility of this method of extracting iodine from samples with iodine concentrations in the ppB-ppM range, and a large combustion apparatus is being built. v) Analytical procedures were developed for measurement and extraction of iodine from different materials, such as soils, water, and plant and animal tissue. (auth)

29605 (HASL-289) VARIATIONS IN NATURAL ENVIRONMENTAL GAMMA RADIATION AND ITS EFFECT ON THE INTERPRETABILITY OF TLD MEASUREMENTS MADE NEAR NUCLEAR FACILITIES. Burke, G. deP. (USAEC Health and Safety Lab., New York). Feb 1975. 26p. Dep. NTIS $4.00.

Monthly measurements made with LiF (TLD-700) thermoluminescence dosimeters at several sites for two years form the basis of a study of the variations in natural environmental radiation both with location and with time. Various methods for estimating environmental exposures in the absence of direct measurements are examined. They include the assumptions that natural environmental radiation does not vary with location and time and the use of a model based on the soil-water balance for estimating exposure variations with time at any particular location. Included is a discussion of the applicability of the various techniques for accurately subtracting background radiation from total exposure measurements for the purpose of isolating exposures attributable to the release of radioactivity from nuclear facilities. Examples are presented of TLD measurements made in the vicinity of nuclear power plants analyzed to isolate plume exposures. The results are compared with ionization chamber measurements of plume exposure and estimates made with models based on reactor effluents and meteorological conditions. (auth)

29606 (SAND-75-5003) ENVIRONMENTAL DYNAMICS OF TOXIC RELEASES AND THE TRANSPORT TO MAN. Chapman, L. D.; Cuddihy, R. G.; Wayland, J. R.; Dugan, V. L.; McClellan, R. O. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. Contract AT(29-1)-789. 8p. (CONF-750418-1). Dep. NTIS $4.00.

From 6th annual conference on modeling and simulation; Pittsburgh, Pennsylvania, USA (24 Apr 1975).

A system dynamics model has been developed to explore the long term distribution of transuranics released into the environment. This general model allows for assessment of the time dependent distribution of release including dispersal within the environment, integration within the food chain, and transport to man of various effluents. (auth)

29607 (STI/PUB-385) OBJECTIVES AND DESIGN OF ENVIRONMENTAL MONITORING PROGRAMMES FOR RADIOACTIVE CONTAMINANTS. Safety Series No. 41. (International Atomic Energy Agency, Vienna (Austria)). 1975. 140p. IAEA $8.00.

Guidance is presented for the development of radiation monitoring programs and procedures relevant to the use of radiation sources and radioactive materials and the operation of nuclear facilities. The interpretation of results of environmental monitoring in terms of the assessment of the possible radiation dose to man is stressed. (CH)

29608 (UCRL-76318) ESTIMATING ATMOSPHERIC TRANSPORT, DIFFUSION, AND DEPOSITION OF RADIOACTIVITY FROM PEACEFUL NUCLEAR EXPLOSIVES. Progress Since 1971. Knox, J. B.; Peterson, K. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1975. 78p. (CONF-750109-8). Dep. NTIS $7.00.

From 4th IAEA panel on peaceful nuclear explosives; Vienna, Austria (20 Jan 1975).

Progress is reported that is applicable to calculating the atmospheric transport, diffusion, and deposition of radioactivity produced by possible peaceful nuclear explosive (PNE) projects. A long-range diffusion model was improved by the addition of a scale dependent approach to specifying the horizontal standard deviation. In addition a particle-in-cell method of simulating the three-dimensional transport and diffusion of instantaneous or continuous releases was developed. The two models agree well in the absence of vertical wind shear. Investigations of precipitation scavenging demonstrated the ability of deep rain storms to deposit the full vertical integral of a radioactive cloud if the two clouds interact. A model was developed to calculate the dry deposition dose from tritiated water vapor via various food pathways. Another model yields surface deposition values of tritium during precipitation. The dispersion of radioactive cloud trajectories from multiple salvos of possible PNE cratering applications was estimated from published balloon data. The resultant multiple salvo population doses are a factor of a few to several times the dose from a single salvo that is assumed to encounter a precipitation system. (CH)

Atmosphere

Refer also to abstracts 29601 and 29682.

29609 (EGG-1183-1638) POPULATION EXPOSURE TO NATURAL TERRESTRIAL GAMMA RADIATION AROUND SELECTED NUCLEAR POWER PLANT SITES. Burson, Z. G. (EG and G, Inc., Las Vegas, Nev. (USA)). 24 Jul 1974. 48p. Dep. NTIS $5.50.

The average dose rates from external penetrating natural terrestrial gamma radiation were determined from airborne survey data for specific areas surrounding each of 20 nuclear power plants. This dose rate information was combined with population distribution data to obtain the average tissue dose-equivalent rate per person. This evaluation covers 19,400 square miles, inhabited by 4.4 million people. Average dose-equivalent rates ranged from a low of 18 mrem/yr at Oyster Creek to 113 mrem/yr at Fort St Vrain. For 18 sites in the Northeastern and North-central United States the mean terrestrial dose-equivalent rate per capita was 46 mrem/yr, while the areal average without regard to population distribution was 43 mrem/yr. In comparison, cosmic ray levels for the 18 sites range from 29 to 32 mrem/yr for elevations from 0 to 1200 ft above sea level. (auth)

29610 (ORO-3944-8) ATMOSPHERIC HT AND HTO, 1972–1974. Tritium Laboratory Data Report No. 4. Oestlund, H. G.; Mason, A. S. (Miami Univ., Fla. (USA). Rosenstiel School of Marine and Atmospheric Sciences). Mar 1975. 69p. (UM-RSMAS-75014). Dep. NTIS $6.50.

Results are presented for measurements of tritium in atmospheric water vapor and rains (HTO) and of atmospheric tritium gas (HT). The rain data originate from monthly samples of precipitation collected at Miami, Florida; Apia, Western Samoa; and Seawell Airport, Barbados. These stations are part of the water isotope sampling network operated by the International Atomic Energy Agency (IAEA). For atmospheric vapor and gas sampling, tritium stations are monitored by processing about 3 kg of air per 20-hr period, two to three times per week at three locations–Miami, Florida; Fairbanks, Alaska; and Mauna Loa Observatory, Hawaii. Quasi-synoptic sampling by aircraft from the continental United States to the Antarctic Continent was undertaken, and several vertical profiles of HTO and HT were sampled over the US. With a new version of our sampling device, information has been gathered up to 18.30 km altitude, i.e., well into the stratosphere. No new global-scale HTO injections were observed during this time period, and the seasonal and geographical HTO variations continued in their established pattern. After having shown little or no change for the last several years, the HT inventory of the northern troposphere increased markedly, apparently due to fallout from a series of large underground nuclear tests, late in 1973. The northern hemispheric inventory of about 550 g of T (as HT, DT, and T_2) received an addition of about 80 g (Mason and Östlund, 1974). The southern hemisphere is a little lower in HT, about 500 g of T. With slowly increasing HT and decreasing HTO inventories, the average troposphere now contains more T as gas (~50 T-atoms/mg) than HTO (~20 T-atoms/mg). The lowest layers of the stratosphere are being depleted in HTO, while the slow process of erosion of HTO from higher altitudes continues. It is difficult to estimate the global inventory of atmospheric HTO-tritium, since about 80% of it is in the stratosphere, and good data are available only from the Antarctic stratosphere in 1971 and 1972 and middle northern latitudes in 1974. The best estimate is about 4000 g of T as of the middle of 1974. (auth)

29611 (ORO-3944-9) STUDY OF TRITIATED HYDROGEN AND ITS COMPOUNDS IN THE ENVIRONMENT. Progress Report, July 1, 1974–March 31, 1975. Oestlund, H. G. (Miami Univ., Fla. (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1975. Contract AT(40-1)-3944. 18p. (UM-RSMAS-75015). Dep. NTIS $4.00.

Two major accomplishments during the third year of the contract were a shipborne transect of the Pacific from California to Antarctica, and the development of a catalytic technique for sampling tritiated atmospheric hydrocarbons. The former project yielded HT and HTO samples each 3° of latitude over a 110° span. The ground-level HT/HTO sampling network was expanded by installation of a sampler at Baring Head, New Zealand. Preparations were made for participation in the AIRSTREAM project of stratospheric sampling. (auth)

29612 FRACTIONATION OF FISSION PRODUCT MIXTURES. Mueller, K.; Burmester, M.; Schuricht, V. (Technische Universitaet, Dresden). Isotopenpraxis; 11: No. 2, 49-52(Feb 1975). (In German).

Fission products deposited on the earth surface frequently have a composition deviating from the values to be expected theoretically. A fractionation takes place which above all has been thoroughly investigated on the fallout of nuclear test explosions. Numerous works published in literature show that there exists an empirical correlation between fractionation factors of a fallout sample which is approximately applicable even for different conditions of explosion. This correlation formalism, a good approximation provided, may be used for the calculation of the composition of fission product mixtures, if the fallout particles have originated as a result of the condensation of a fireball. (auth)

29613 SEASONAL DISTRIBUTION OF ^{137}Cs IN RAINFALL, COMPARED WITH THE GENERAL ARTIFICIAL β-RADIOACTIVITY OF THE FALLOUT IN SOFIA, PLEVEN, AND VARNA IN 1970–1971. Georgieva, L.; Dimchev, T. Khidrol. Meteorol.; 23: No. 1, 19-29(1974). (In Bulgarian).

The fallout ^{137}Cs β-activity level due to nuclear explosions carried out in the northern hemisphere in 1970-71 is not higher than in the preceding biannual period. The ^{137}Cs activity had distinct spring and summer maxima. The overall activity is low compared with the general artifical β activity deposited in the period examined and is ~3 to 4.5% of the latter. The fall minima of the artificial β activity deposited do not correspond to the minima of the rainfall totals. The spring maxima correlate well with the ^{137}Cs activity deposited. (ERB)

29614 THE RELATIVE CONCENTRATIONS OF RADON DAUGHTER PRODUCTS IN SURFACE AIR AND THE SIGNIFICANCE OF THEIR RATIOS. Rangarajan, C.; Gopalakrishnan, S.; Chandrasekaran, V.R.; Eapen, C.D. (Air Monitoring Section, Bhabha Atomic Research Centre, Bombay, India). J. Geophys. Res. 80: No. 6, 845-848 (20 Feb 1975).

The ratios of short–lived radon (^{222}Rn) daughter product activity to long–lived ^{210}Pb in surface air at a few stations in India are compared with similar ratios at a number of other locations. It is noted that, where systematic measurements are available, the seasonal changes in the activity ratios are within a factor of 2. Also, all the available average ratios from the various locations fall within the limits 6000 ± 5000. It is suggested that with properly averaged ratios the aerosol residence time can be calculated correct to possibly a factor of 2 if vertical diffusion is also taken into account. Some advantages of using the ratios of $Rn/^{210}Pb$ compared with other pairs of isotopes for calculating aerosol residence times are pointed out. (auth)

29615 A SIMPLE AUTOMATIC SAMPLING DEVICE FOR ENVIRONMENTAL TRITIUM AIR MONITORING. Duftschmid, K. E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). pp 597-608 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Monitoring of airborne tritium (HTO) concentration plays an important role for the assessment of environmental hazards caused by nuclear installations. A simple automatic monitoring device was developed, which provides high detection sensitivity at minimum labor and equipment expense. The technique used is an improvement of the "cold-pipe" sampler. Air is drawn through the cold-trap of a thermoelectric cooler by the pump of a small vacuum cleaner and the condensed water collected in the counting vial of a liquid scintillation counter. Once a day the vial is automatically changed by a simple rotating tray mechanism. Every week the samples are removed and assayed with no further sample preparation. Increased sensitivity as compared to the generally used "bubbler" is achieved as there is no dilution of the sample. Due to frequent electric defrosting of the cooler the airflow is sufficiently constant to make volume measurement or calculation via temperature/humidity unnecessary. The limit of detection is in the range of 10 pCi/m^3 for continuous occupational exposure. The prototype unit has been field-tested at the site of the Austrian Reactor Centre Seibersdorf. The test results show that reliability and economy of environmental tritium contamination monitoring can be significantly improved by this simple device. Due to its nearly unattended and continuous operation the sampler is especially suitable for extended monitoring networks around nuclear installations. (FR)

29616 SURVEY AND MONITORING OF CONFINEMENT IN A PLUTONIUM IRRADIATED FUEL EXAMINATION FACILITY. Tamas, M. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service de Protection contre les Rayonnements). pp 555-567 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The monitoring of airborne contamination, used for the supervision of efficiency of containment, is described. It is based on the device presently used in the Irradiated Fuel Examination Facility of the Fontenay-aux-Roses Nuclear Study Center. The monitoring network, the sampling devices with later computing, the alarm monitors and the computing system are described. The central control panel, which groups all the information on health physics and classical safety, is also described. The monitoring by filter computing is then studied. The advantages of a great number of small sampling heads, connected to a single network with only one fan and dispatched at the different working places, are given, as well as the advantages and disadvantages of monitoring with individual sampling devices. Finally, the possibilities resulting from computer utilization for exploitation of results are studied. (FR)

29617 ENVIRONMENTAL MONITORING FOR DISCRIMINATING LOW-LEVEL PLUME EXPOSURE FROM FLUCTUATION BACKGROUND RADIATION. Moriuchi, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Genshiryoku Kogyo; 20: No. 5, 19-23(May 1974). (In Japanese).

As the technique for reducing radioactive rare gas released from commercial nuclear power plants have been improved, the general tendency is to make a target of design and operation for environmental exposure of 5 mrem per year. Separate evaluations were made of the contribution by nuclear facilities and of the fluctuating component of background radiation. The means for separate evaluations are: each contribution may be separated by applying fluctuation analysis often used in reactor physics, the energy spectrum difference may be used, and the differences of regional and time pattern changes of Rn daughter nuclides accumulating temporarily on the ground after rain are employed. As an actual example of the separate measurement, results with a separation system due to rain-fall, located 350 m NNW from JRR-2 stack of JAERI, are indicated. (JA)

Soil

29618 (UCRL-76419) RESUSPENSION AND REDISTRIBUTION OF PLUTONIUM IN SOILS. Anspaugh, L. R.; Shinn, J. H.; Phelps, P. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1975. 37p. (CONF-740550-5). Dep. NTIS $5.00.

From 2nd annual life sciences symposium on plutonium–health implications for man; Los Alamos, New Mexico, USA (22 May 1974).

Formulas were derived, which parameterize dust and plutonium fluxes in terms of micrometeorological and soil erodibility parameters. Interim, simple models utilizing the time-dependent resuspension factor and mass-loading approaches are derived which may be used to predict the average concentration of resuspended plutonium. Intensive measurements of the resuspension of plutonium at the USAEC's Nevada Test Site are summarized in terms of a resuspension rate through the use of Healy's model of transport and diffusion. Values of the resuspension rate varied from 2.7×10^{-12} to 4.8×10^{-10} sec^{-1}. The relationship between the resuspension rate and the historical resuspension factor is developed. The various models and formulations used are shown to be internally consistent for this experimental site. (auth)

Water

Refer also to abstract 29667.

29619 (FFIF-F-605) IODINE CONTENTS IN DRINKING WATER AND PRECIPITATION FROM VARIOUS PLACES IN NORWAY, SPRING AND SUMMER 1974. Viste, A. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Oct 1974. 17p. (In Norwegian). Dep. NTIS (US Sales Only) $4.00.

The contents of fallout ^{131}I in drinking water and precipitation in Norway were measured. Samples of drinking water were collected at 8 different places in Norway. Precipitation was collected at 3 different meteorological stations. In general the ^{131}I content in drinking water was low (1.3 to 3.2 $\mu g/l$). The highest values were found at Vaernes and Kjeller–the lowest values at Røros, Bardufoss and Kautokeino. Summer values were not significantly higher than spring values. Iodine contents in precipitation were found to be of the same level as in drinking water. The highest value was found in Bergen. (NO)

29620 (HW-45721) REACTOR EFFLUENT MONITORING. Healy, J. W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 12 Oct 1956. 30p. Dep. NTIS $4.50.

Declassified 1 Nov 1971.

Criteria for radiation monitoring of radioisotopes discharged to the Columbia River in Hanford reactor effluent wastes in 1956 are reviewed. At that time the chief concern was with the buildup of ^{32}P in aquatic organisms, especially fish. Programs to evaluate the possible hazards to humans or aquatic life making use of the river water either directly or indirectly are discussed. (CH)

29621 RADIOACTIVITY OF NEVADA HOT–SPRING SYSTEMS. Wollenberg, H.A. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Geophys. Res. Lett. 1: No. 8, 359-362 (Dec 1974).

Field gamma radiometry and laboratory gamma–ray spectrometry of waters and spring deposits were accomplished for some hot–spring systems in northern Nevada. Gamma–ray exposure rates measured on–site range from 2 to 500 μR/hr, and depend mainly on the amounts of the natural radioelements, in the spring deposits. High radioactivities, primarily from ^{226}Ra, are associated with hot–spring systems dominated by $CaCO_3$, while silica–dominated systems are relatively low in radioactivity. Gamma spectrometry disclosed the enrichment of ^{226}Ra with respect to its parent U in $CaCO_3$-dominated systems. ^{226}Ra preferentially associates with Ca; therefore, where tufa and siliceous sinter are present in a deposit, the calcareous material is highest in radioactivity. Spring deposits at fast–flowing $CaCO_3$ dominated systems are generally less radioactive than calcareous deposits at slower flowing springs. (auth)

29622 DETERMINATION OF TRITIUM IN MILK AND SURFACE WATER FROM THE IMMEDIATE SURROUNDINGS OF A NUCLEAR POWER PLANT IN THE NORTH OF GERMANY. Wiechen, A. (Bundesanstalt fuer Milchforschung, Kiel (F. R. Germany). Inst. fuer Physik). Milchwissenschaft; 29: No. 6, 346-348(Jun 1974). (In German).

Analyses of samples of milk and surface water originating from the immediate surroundings of the largest PWR that actually exists in Federal Germany have not provided any basis for an assumption that this power plant had contributed to the tritium contamination of the samples. These results confirm calculations suggesting that no problems are actually involved in tritium contaminations by nuclear power plants of the existing order of size. The analyses will be continued in order to obtain data for securing evidence. (GE)

29623 STUDIES ON THE ADSORPTION BEHAVIOR OF RADIOCOBALT IN SEA WATER. Suzuki, E. (Tokai Regional Fisheries Research Lab., Tokyo (Japan)); Ikeda, N. Radioisotopes (Tokyo); 23: No. 7, 373-379(Jul 1974). (In Japanese).

The adsorption of Co of trace concentration in seawater on the hydroxides of Fe, Al, Mn, Si, and marine sediments and ion-exchange resins was studied. The degree of adsorption on hydroxides increased as the pH value of seawater was increased from 6 to 9, and the adsorption of Co on the hydroxides of Al, at pH value 9, was higher in the artificial seawater than in the natural seawater. The minimum distribution coefficient of Co was obtained at pH value 7 with both marine sediments assayed in this work, although the cation exchanger showed a slight decrease of adsorption accompanied with the increase of pH value of seawater from 5 to 9. From the values of distribution coefficients of Co on the sediments and ion exchanger of the varied concentrations in seawater, it was presumed that one of the sediments functioned as a single sort of adsorbent similar to the cation exchanger, but in the case of another sediment, there accompanied some other kind of adsorption in addition to cation exchange. The adsorption of Co to the sediments and cation exchanger was reduced as the concentration of glycine and glycollic acid in seawater was increased. As to the other kind of amino acids, aspartic acid showed the distinguished effect of hindrance to the adsorption in comparison with alanine, leucine, and glutamic acid, which showed the adsorption of the similar degree to glycine. On the other hand, lysine showed the promotive effect on the adsorption unlike the other amino acids assayed in this work. It was observed that interfering effect of amino acids on the adsorption of Co was dominated by the chelate formation constant of amino acids with Co^{2+}. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 29863, 29901, 29961, and 29972.

29624 (EUR-5271e) STUDIES ON THE RADIOACTIVE CONTAMINATION OF THE SEA. Annual Report, 1972. Bernhard, M. (ed.). (Comitato Nazionale per l'Energia Nucleare, La Spezia (Italy). Lab. per lo Studio della Contaminazione Radioattiva del Mare). 1974. 141p. Dep. NTIS (US Sales Only) $10.25.

The Annual Report of the CNEN-Euratom Association Contract is presented. Progress is reported on studies of the factors that influence the uptake, accumulation, and loss of radioisotopes by different inorganic and organic constituents of the marine environment. The program is divided into two parts: the investigation of relevant radioecological and ecological factors in nature and under laboratory conditions; and the investigation of the outfall area off-shore of the CNEN-Trisaia Center in the Gulf of Taranto (nuclear fuel-reprocessing plant). (auth)

29625 (NP-20350) INVESTIGATIONS OF RADIOACTIVE FALLOUT IN HUMANS AND FOODSTUFFS IN NORWAY. Annual Report. Christensen, G. C.; Pappas, A. C. (Oslo Univ. (Norway)). Feb 1974. 40p. (In Norwegian and English). Dep. NTIS (US Sales Only) $5.00.

Results of measurements of ^{90}Sr in human bone from subjects in Norway who died in the years 1972 and 1973, of ^{90}Sr and ^{137}Cs in Norwegian cheese, and ^{90}Sr in vegetables and corn in Norway in 1972 and 1973 are presented. All levels appear now to be relatively constant. (NO)

29626 (UCLA-12-986) $^{239-240}Pu$ AND ^{241}Am CONTAMINATION OF VEGETATION IN AGED PLUTONIUM FALLOUT AREAS. Romney, E. M.; Wallace, A.; Gilbert, R. O.; Kinnear, J. E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). Feb 1975. Contract AT(04-1)-GEN-12. 52p. Dep. NTIS $4.00.

Data are presented on the $^{239-240}Pu$ and ^{241}Am contents of vegetation samples collected in conjunction with the soil sampling program in aged plutonium fallout areas on the Nevada Test Site (NTS) and the Tonopah Test Range (TTR). Radiochemical analyses indicate definite variations in the contamination levels from sample to sample collected within a given activity stratum. Variations also occur in the contamination levels on different plant species, which can be attributed to differences in the amounts of resuspendable particulate material superficially entrapped upon plant foliage. In spite of these variations, there were some indications of reasonable agreement between the mean activity levels of $^{239-240}Pu$ in vegetation and soil samples. (CH)

29627 (UCRL-76552) FRESHWATER ENVIRONMENT. Harrison, F. L.; Ophel, I. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Feb 1975. 11p. (CONF-750122-1). Dep. NTIS $4.00.

From national academy of sciences workshop; Washington, District of Columbia, USA (7 Jan 1975).

The physical and chemical characteristics of standing-water systems are quite diverse. Ecosystems can differ by several orders of magnitude in the volume and depth of water they contain. Inorganic salts are present in widely different concentrations and composition. Radionuclides introduced into the freshwater ecosystems by fallout deposits or from other sources are partitioned between the water and particulates and are accumulated by the biota in the various trophic levels. Concentrations of radionuclides in freshwater organisms are dependent on the amount of radioactivity the ecosystem receives, on the physicochemical characteristics of each radionuclide, on the chemical and physical properties of the ecosystem, and on the metabolic pathways in the organisms. The importance of these factors differs with the organism, the radionuclide, and the environment. Of the long-lived radionuclides under consideration ^{137}Cs and $^{238,239,240,241}Pu$ can be expected to be removed by sedimentation processes, whereas ^{3}H, ^{14}C, and ^{90}Sr can be expected to behave essentially as conservative substances in the water phase. Very little information is available on the distribution of ^{129}I and ^{241}Am in freshwater ecosystems. If it is assumed that ^{129}I behaves like ^{131}I, the distribution coefficients for ^{131}I indicate that ^{129}I would be present primarily in the water phase. If it is assumed that ^{241}Am behaves the same in freshwater as it does in seawater, most of it would be present in the sediments. (CH)

29628 EXPERIMENTAL ANALYSIS OF ZINC SALT TRANSFER TO FINAL CONSUMER IN A FRESHWATER ECOSYSTEM. Parouty, G.; Chaisemartin, C. (Limoges Univ., 87 (France)). Compt. Rend. Soc. Biol.; 168: No. 1, 78-82(1974). (In French).

A study of the transfer of a micropollutant, ^{65}Zn, to a secondary consumer showed that contamination through the food chain was very low as compared with that resulting from the environmental water. In the predator, there occurred a threshold for contamination by ingestion and partial rejection of the micropollutant in excess. At sublethal levels biological concentration through the food chain only is difficult to obtain. (FR)

29629 THE APPLICATION OF FOOD AND ANTI-POLLUTION REGULATIONS IN THE ASSESSMENT OF RADIOACTIVELY CONTAMINATED FOODS. Schulze, H. (Muenchen Univ. (F. R. Germany). Tieraerztliche Fakultaet). Arch. Lebensmittelhyg.; 24: No. 11, 258-259(Nov 1973). (In German).

It is necessary to improve the protection of the consumer against residues by better food legislation. This can only be achieved by a synchronized reform of all other regulations concerned. Authorities responsible in this field should improve cooperation. (auth)

29630 ESTIMATION AND EVALUATION OF RADIOACTIVE CONTAMINATION THROUGH A FOOD WEB IN AN AQUATIC ECOSYSTEM, 1. An Application of the Compartment Model to Transfer of Radioactive Substances Through a Food Chain. Aoyama, I.; Inoue, Y. (Kyoto Univ. (Japan). Faculty of Engineering). J. Radiat. Res.; 14: No. 4, 375-381(Dec 1973).

Transfer of radioactive substances through a food chain in an aquatic ecosystem was analyzed through application of modified

three compartment model of Aten's. Modification of the original model is an introduction of two processes, an excretion of radioactivity from Fish-1 (preys) to seawater and an direct uptake of radioactivity by Fish-2 (predator) from seawater. In the model, a following ratio rate coefficient (k_{12}) was defined as a mass transfer coefficient of a radioactive nuclide from preys to a predator: $k_{12} = M_1/M_2$ where θ is an assimilation rate of a radioactive nuclide, M_1 is a daily average ration taken by a predator, and M_2 is a weight of the predator. In the experimental system, pike cichlids and minnows were used as predators and preys. And ^{137}Cs was used as a radionuclide in the system. The accumulation of a ^{137}Cs in pike was explained by application of the above modified three compartment model and various parameters in the model were determined. This shows that the transfer of a radionuclide through a food chain can be estimated by knowing the uptake rate and the turnover rate of Fish-2 [predator]. They in ecological term are a daily average ration and an assimilation rate respectively. (auth)

Radiometric Techniques

Refer also to abstract 29582.

29631 $^{40}Ar/^{39}Ar$ INCREMENTAL RELEASE AGES OF BIOTITE FROM THE CHEROKEE OREBODY, DUCKTOWN, TENNESSEE: THEIR BEARING ON THE AGE OF SULFIDE MINERALIZATION. Dallmeyer, R. D. (Univ. of Georgia, Athens). Econ. Geol.; 70: No. 2, 341-345(1975).

$^{40}Ar/^{39}Ar$ total gas ages of 435, 424, and 372 m.y. (all ± 15 m.y.) have been determined for biotite separates from the Cherokee orebody at Ducktown, Tennessee. $^{40}Ar/^{39}Ar$ ages of incrementally released gas fractions show negligible variation and in all cases are similar to the total gas ages of the samples. This correlation suggests that the ages represent times of postcrystallization cooling when argon began to be retained within biotite. The ages are closely associated with the regional thermal history of the Blue Ridge during its uplift following Middle Paleozoic metamorphism at ~480 m.y. and rule out those theories of ore genesis which relate sulfide mineralization to a Late Paleozoic (Appalachian) orogenic event. (auth)

29632 ISOTOPIC ANALYSIS OF THE HAILSTORM OF AUGUST 19th, 1971 IN THE CLERMONT-FERRAND REGION. Jouzel, J.; Merlivat, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91—Gif-sur-Yvette (France). Section des Recherches et de l'Interaction du Rayonnement avec la Matiere). J. Rech. Atmos.; 7: No. 4, 167-174(Oct 1973). (In French).

The measurement of mean deuterium content in hailstones, previously classified according to morphological criteria, shows that a relationship between the classification and isotopic content exists. (FR)

29633 K-Ar AGES OF GRAVELS OF ORTHOQUARTZITE AND GNEISS FROM THE MURO GROUP. Shibata, K.; Nozawa, T. (Geological Survey of Japan, Kawasaki, Kanagawa). Chishitsu Chosasho Geppo; 24: No. 11, 551-553(Nov 1973). (In Japanese).

A K-Ar age of 309 m.y. was obtained for a whole-rock sample of orthoquartizite cobble from the Muro group in Soshima, Kii Peninsula. This age may indicate either the time of sedimentation of orthoquartzite, or the time of metamorphism or alteration of orthoquartzite. Biotite and muscovite from a boulder of granitic gneiss from the Muro group in Soshima yield K-Ar ages of 63.3 and 70.4 m.y. respectively. These ages are similar to those of the Ryoke granites, suggesting that the provenance of the gneiss may be the Ryoke metamorphic belt. (auth)

29634 ^{14}C-AGE OF TOWABA-B ASH FALL. ^{14}C-Age of the Quaternary Deposits in Japan, (96). Oike, S. (Aomori Prefectural Hachinohe Senior High School (Japan)); Shoji, S. Chikyu Kagaku; 28: No. 3, 99-100(May 1974). (In Japanese).

The pyroclastic falls derived from the repeated activities of the central cone of Towada Volcano in the time ca. 9,000—1,000 y.B.P. are Ninokura volcanic ash, Nanbu pumice, Chuseri pumice, Towada-b ash fall and Towada-a ash fall, mentioned from lower to upper level. The chronological situation of these deposits is discussed in relation to ^{14}C-age and human remains. For two samples newly collected in Sodehira Pasture from the layers of humic volcanic-ash mud immediately above and below the b ash fall respectively, ^{14}C-age determination (for humic acid extracted from the samples) was done by Prof. K. Kogoshi, and the age was given as 1,180 ± 80 y.B.P. for sample 1 and 2,220 ± 100 y.B.P. for sample 2. These age values harmonize with the stratigraphy of the samples and the relation to human remains. While, ^{14}C-age values for Towada-a fall previously reported as 1,450 ± 100 y.B.P. (Hakkōda Research Group, 1969) and 2,140 ± 90 y.B.P. (Matsui, et al, 1969) are somewhat older as compared with the above values, and considered from the stratigraphic relation to human remains. (JA)

29635 ^{14}C-AGE OF KAMUINUPURI VOLCANIC ASH SOILS IN SHIBECHA, KAWAKAMI-GUN, HOKKAIDO. ^{14}C-Age of the Quaternary Deposits in Japan, (97). Shoji, S.; Masui, J. (Tohoku Univ., Sendai (Japan). Faculty of Agriculture). Chikyu Kagaku; 28: No. 3, 101(May 1974). (In Japanese).

A number of black humus seams are intercalated in volcanic ash layer observed in Hagino, about ten kilometers SES of Kamuinupuri. To determine the age of this volcanic ash, which shows extensive distribution in Abashiri-Kushiro district and whose early-stage weathering was studied by the authors, the humic acid extracted from two humus seams (upper sample, No. 177 and lower sample, No. 181) was used for ^{14}C-age determination. It was done by Prof. K. Kigoshi, and the ages were 980 ± 100 y.B.P. (No. 177) and 1,700 ± 100 y.B.P. (No. 181). For these samples, somewhat younger ages have been estimated by Yamada (1958). (JA)

29636 ^{14}C-AGE OF PEAT SOIL IN THE VICINITY OF FURUKAWA CITY, MIYAGI PREFECTURE. ^{14}C-Age of the Quaternary Deposits in Japan, (98). Shoji, S.; Kaneko, S.; Masui, J. (Tohoku Univ., Sendai (Japan). Faculty of Agriculture). Chikyu Kagaku; 28: No. 3, 102(May 1974). (In Japanese).

A thin layer of volcanic ash has been known, which is intercalated in the upper portion of peat bed widely distributed in the vicinity of Furukawa City. This volcanic ash layer, consisting of fine glassy particles, is also well preserved in clay-rich, peat-accompanying sediments found in lowland moors behind river area, and forms an important key-bed for the elucidation of alluvial plain development or of weathering process of clay-minerals. The authors collected peat samples for ^{14}C-age determination, at the western part of Furukawa City, from peat layers immediately above and below the volcanic ash layer. The age determination was done by Prof. K. Kigoshi on the humic acid extracted from the peat, and the ages were given as 770 ± 80 y.B.P. (the upper peat) and 860 ± 90 y.B.P. (the lower peat). (JA)

29637 USE OF NATURAL ISOTOPIC TRACERS IN STUDYING THE FUNCTIONING OF A KARSTIC SYSTEM: OXYGEN-18 CONTENTS OF THREE SYSTEMS IN THE PYRENEES, FRANCE. Bakalowicz, M.; Mangin, A. (CNRS, Moulis, France). J. Hydrol.; 23: No. 1, 141-158(Oct 1974). (In French).

Three karstic systems in the Pyrenees (France) were subjected to a monthly systematic sampling in view of isotopic analysis of oxygen-18. In addition, a higher frequency sampling in overflow conditions has been made in one of the systems which is also continuously studied as regards hydrodynamics, geochemistry, and biology. After analyzing the sample representativity, an attempt was made to find out the meaning of the variations of the contents in oxygen-18 in function of time. In the case of these systems of the Pyrenees, a relation between altitude of the catchment area and the contents in oxygen-18 of their risings was established that does not agree with Dansgaard's relation. The variations of isotopic contents in function of the hydrogeologic events confirm the heterogeneity of the submerged zone and the importance of the part played by the percolation, chiefly by considering the connection with the surface saturated zone, named "epikarstic aquifer". These results, obtained with those of hydrodynamic, geochemical, and biological studies of the karst, are not likely to be interpreted without the help of these disciplines. (NL)

29638 TRANSFORMATION OF S35-LABELLED SULPHATE IN AEROBIC AND FLOODED SOIL CONDITIONS. Sachdev, M. S.; Chhabra, P. (Indian Agricultural Research Inst., Delhi). Plant Soil; 41: No. 2, 335-341(Oct 1974).

In the present study an investigation about the transformation of added S^{35}-labelled sulphate sulphur in an alluvial soil under aerobic and flooded soil conditions was made. After four months of incubation under laboratory conditions it was found that while in aerobic condition 68.1% of the added sulphate is present, in case of flooded conditions it is only 12.7%. The main transformation was into organic forms that is 28.1 and 37.8% in aerobic and flooded soil conditions respectively. In aerobic condition 99% of the added sulphate sulphur could be accounted for in different fractions determined, viz sulphate, organic, humus, amino acid and evolved hydrogen sulphide sulphur. In flooded condition only 56% was present in all these fractions, which indicates that remaining 44% is in chemical forms between SO_4^{-2} and S^{-2}. (NL)

29639 STUDY OF THE INFILTRATION AND RECHARGE THROUGH THE SAND DUNES IN ARID ZONES WITH SPECIAL REFERENCE TO THE STABLE ISOTOPES AND THERMONU-

CLEAR TRITIUM. Dincer, T. (Food and Agriculture Organization of the United Nations, Riyadh, Saudi Arabia); Al Mugrin, A.; Zimmermann, U. J. Hydrol.; 23: No. 1, 79-109(Oct 1974).

Observations of the temperature gradients, moisture content, size distribution of the sand, and tritium, deuterium and oxygen-18 content of the moisture in the sand dunes in a very arid region show that a significant portion of an annual rainfall of about 80 mm infiltrates through the sand dunes and can be a source of major recharge to the aquifer formation outcrops covered by the sand dunes. The mechanism of water movement seems to be related closely to the vertical temperature gradients in the sand. The water infiltrating to the dunes is highly enriched with respect to stable isotopes of oxygen and hydrogen providing a natural label for this type of water. (NL)

29640 DETERMINATION OF GROUNDWATER RECHARGE WITH TRITIUM. Vogel, J. C.; Thilo, L.; van Dijken, M. (Council for Scientific and Industrial Research, Pretoria). J. Hydrol.; 23: No. 1, 131-140(Oct 1974).

As a result of nuclear weapon tests the tritium content of precipitation in South Africa increased to about 20 Tritium Units in 1958 and to above 50 T.U. in 1963. These two distinct rises in the tritium concentration provide a means of determining the average rate at which moisture percolates through the soil to recharge the groundwater reservoir. Taking radioactive decay into account, water with a tritium content of less than 7 T.U. must date from before 1958, values between 7 and 12 T.U. must be ascribed to rainfall in the years 1958-1962 and values of about 30 T.U. to rainfall since 1963. Examples are given to demonstrate that this record is preserved in soil profiles and can be used to calculate groundwater recharge quantitatively. (NL)

29641 THERMOLUMINESCENT LABELLING: USEFUL FOR THE STUDY OF SEDIMENTATION IN RIVERS. Prydz, S.; Mikkelborg, J. E. (Univ. of Oslo). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 92-93(Feb 1975).

The thermoluminescence of many solid inorganic materials on x-irradiation is suggested as a useful label for the study of fine-particle transportation and sedimentation in rivers, etc. The properties required by materials that could be used for this TL method are discussed. It is shown that a factor of 10^{15} should be available, which may be spent on loss, dilution, TL decay during the experiment, and masking during measurement by naturally occurring alluvial particles. It is thought that in view of the very high apparent sensitivity of the proposed method, it could be interesting to see an investigation of its usefulness in a practical situation. (UK)

Site Surveys

Refer also to abstracts 29598, 29599, 29609, and 29626.

29642 (AAEC/E-309) METEOROLOGICAL RESEARCH STUDIES AT JERVIS BAY, AUSTRALIA. Clark, G. H.; Bendun, E. O. K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1974. 100p. Dep. NTIS (US Sales Only) $8.00.

A climatological study of the winds and temperatures of the Jervis Bay proposed nuclear power plant site which commenced in October 1970 showed the presence of a coastal sea breeze and secondary bay breeze circulation system. In June 1972 a meteorological acoustic sounding research program was initiated at the Jervis Bay settlement. The aims of the research are to calibrate the sounder in terms of surface wind, turbulence, and temperature measurements pertinent to a description of the lower atmospheric dispersion potential. Preliminary results on six months' data have shown encouraging correlations between the acoustic sounder patterns and particularly the wind direction turbulence traces. (auth)

29643 (BNWL-1704) VARIABLE THICKNESS TRANSIENT GROUNDWATER FLOW MODEL USER'S MANUAL. DeMier, W. V.; Reisenauer, A. E.; Kipp, K. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 100p. Dep. NTIS $5.45.

The Variable Thickness Transient Flow Model (VTT) is a numerical solution to the partial differential equation describing unconfined saturated transient flow through porous media. This report describes the input to the model and two support programs used during a groundwater aquifer simulation. In addition to the program listings and user and input instructions, specific features relating to modeling of the Hanford Reservation groundwater regime are described. (auth)

29644 (CEA-CONF-2841) PRACTICE AND EXPERIENCE OF SAFETY IN NUCLEAR PLANT SITING IN FRANCE. Candes, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). [nd]. 14p. (CONF-740849-1). Dep. NTIS (US Sales Only) $4.00.

From meeting on nuclear power plant siting; Portland, Oregon, USA (25 Aug 1974).

For the government authority, the building of a nuclear plant in a chosen site sets the problem of particular risks for the public consequently to the release of radioactive effluents in normal operation or in the event of small incidents and in accidental situations. The contents of siting studies in France are discussed in relation to the rules established by the safety authorities. Emphasis is placed on nuclear installation impact on the environment and the impact and stresses of the site on the nuclear installation. The resulting report must provide to the Authority the necessary information to approve or to invalidate the choice of the site and eventually to modify or to complete, in the right direction, the safety arrangements for the installation. In the second part, the author expresses his conception of a methodology permitting the Authority responsible for approving the choice of site, to dispose of rational elements to settle the delicate problem of an acceptable population density in the area surrounding a nuclear installation. This methodology does not lose sight of the necessity of solving such a problem taking into account the particular character of the country or region concerned. From this point of view, it remains essentially pragmatic. (FR)

29645 (LA-UR-74-1953) LIGHTNING FLASH DENSITIES AND CALCULATION OF STRIKE PROBABILITIES TO CERTAIN VULNERABLE INSTALLATIONS AT THE NEVADA TEST SITE (NTS). Buset, K.; Price, K. W. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 14p. (CONF-750419-1). Dep. NTIS $4.00.

From conference on lightning and static electricity; Oxford, UK (Apr 1975).

In the summer of 1972, a program was begun to determine lightning activity characteristics at the Nevada Test Site. Preliminary work performed in 1971 was used to initiate this program and design a practical lightning warning and data procurement system. A major objective of the program was to obtain information on flash densities in areas vulnerable to lightning damage. Instrumentation used in this study was designed to respond in accordance with the results of Dr. E. T. Pierce's work published in 1955 relating mean electric field change magnitude vs distance from a lightning discharge. From the data collected, we were able to calculate flash densities and lightning strike probabilities. The results indicate that lightning flash densities may be found in localized areas and may be used as a guide in location of vulnerable installations. A definite relationship between lightning activity and topographical and meteorological characteristics of the Nevada Test Site were also obtained. It was found that applying generalized lightning activity information for a large geographical area is not adequate in determining lightning strike probabilities and flash densities in portions of that area. The data obtained and subsequent results may be a valuable supplement to associated studies of lightning activity. (auth)

29646 (SAAS-169) REPORT DES STAATLICHEN AMTES FUER ATOMSICHERHEIT UND STRAHLENSCHUTZ DER DDR. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Nov 1974. 24p. (In German). Dep. NTIS (US Sales Only) $4.25.

Separate abstracts were prepared for the two sections of this report. (CH)

For abstracts of individual sections see: 29647 and 29648.

29647 (SAAS-169, pp 3-18) SIGNIFICANCE OF ACCIDENTAL RADIATION EXPOSURE OF INDIVIDUALS AND THE POPULATION FOR NUCLEAR POWER PLANT SITING. Eichhorn, H.; Rohnsch, W. Nov 1974. (In German).

In report des Staatlichen Amtes fuer Atomsicherheit und Strahlenschutz der DDR.

Possible radiation exposures of individuals and the population of the German Democratic Republic caused by nuclear power plant accidents are compared. Several fictive sites including areas with maximum population density were considered. Concerning individuals primarily the exposure of thyroid and whole body may become critical. In the case of pressurized water reactor accidents (coolant loss from the primary circuit) connected with releases of radioactive iodine and rare gases the thyroid exposure is the limiting factor with regard to activity discharges. When the exposure limits (total body 25 rem, thyroid of children 75 rem) provided for the boundary of the exclusion area (radius 1.5 km) are observed the prescribed limit of population exposure (10^6 man-rem) will not be exceeded at any of the examined sites, supposed, however, there are stable weather conditions and ground disposal. At sites of high pop-

ulation density, under differing weather conditions and in the case of stack disposal, population exposure may become the determining factor with regard to activity releases. (auth)

29648 (SAAS-169, pp 19-23) ASSESSMENT OF QUALITY DEVIATIONS DURING NUCLEAR POWER PLANT CONSTRUCTION. Bergemann, W. Nov 1974. (In German).

In report des Staatlichen Amtes fuer Atomsicherheit und Strahlenschutz der DDR.

The possibilities of nuclear and technical safety enhancement by systematic assessment and analysis of quality deviations, particularly during nuclear power plant construction, are discussed. A data collection sheet is given as an example. (auth)

29649 (SCP-2.28.01-2) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT: MAIN REPORT. Prospective Site: Vardeaasen (Rygge). Killerud, K.; Tveten, U. (Scandpower A/S, Oslo (Norway)). 18 Jun 1974. 71p. (In Norwegian). Dep. NTIS (US Sales Only) $6.75.

Atmospheric dispersion was calculated on the basis of meteorological data for the Vardeåsen (Rygge) proposed nuclear power plant site on the Oslofjord. Releases of radioactive materials from both BWR and PWR type reactors under normal operation and following loss of coolant accidents (two for each reactor type, corresponding to different assumptions of conditions following the accident) together with population data were used to calculate the resulting radiation doses to human populations. (NO)

29650 (SCP-2.28.01-3) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT: MAIN REPORT. Prospective Site: Moerk (Vestby). Killerud, K.; Tveten, U. (Scandpower A/S, Oslo (Norway)). 4 Jul 1974. 71p. (In Norwegian). Dep. NTIS (US Sales Only) $6.75.

Atmospheric dispersion was calculated on the basis of meteorological data for the Mørk (Vestby) proposed nuclear power plant site on the Oslofjord. Releases of radioactive materials from both BWR and PWR type reactors under normal operation and following loss of coolant accidents (two for each reactor type, corresponding to different assumptions of conditions following the accident) together with population data were then used to calculate the resulting radiation doses to human populations. (NO)

29651 (SCP-2.28.01-5) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT: SUPPLEMENTARY REPORT, METEOROLOGICAL CONDITIONS. Prospective Sites: Skjoettelvik (Hurum), Vardeaasen (Rygge), Moerk (Vestby), and Naverfjorden (Brunlanes). Killerud, K.; Dovland, H.; Sivertsen, B. (Scandpower A/S, Oslo (Norway)). 28 Jan 1974. 133p. (In Norwegian). Dep. NTIS (US Sales Only) $9.75.

The meteorological data on which the atmospheric dispersion and radiation dose calculations for the four prospective nuclear power plant sites on the Oslofjord, Skjøttelvik (Hurum), Vardeåsen (Rygge), Mørk (Vestby) and Naverfjorden (Brunlanes) are presented. Following a general presentation of the climatic conditions in the Oslofjord region the data for wind and its stability are discussed. Data for accident situations and normal operation are given and comments made on the persistence of wind direction and stability and dispersion parameters and their accuracy. Data are presented in tabular form and in maps. (NO)

29652 (SCP-2.28.01-6) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT: SUPPLEMENTARY REPORT, POPULATION DISTRIBUTION AND PROGNOSES. Prospective Sites: Skjoettelvik (Hurum), Vardeaasen (Rygge), Moerk (Vestby), and Naverfjorden (Brunlanes). Killerud, K. (Scandpower A/S, Oslo (Norway)). 24 Jan 1974. 53p. (In Norwegian). Dep. NTIS (US Sales Only) $5.75.

The population distributions in 5 km radius, 30 km radius, and 100 km radius zones around the four prospective nuclear power station sites in the Oslofjord district, Skjøttelvik (Hurum), Vardeåsen (Rygge), Mørk (Vestby) and Naverfjorden (Brunlanes) are briefly discussed and presented on maps and in tables. A prognosis of the population development to the year 2000 is also discussed and presented in tables and maps. (NO)

29653 (SCP-2.28.05-1) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT: SUPPLEMENTARY REPORT. Population Distribution and Prognoses, Prospective Site: Saga (Porsgrunn). Killerud, K. (Scandpower A/S, Oslo (Norway)). 28 May 1974. 37p. (In Norwegian). Dep. NTIS (US Sales Only) $5.00.

The population distributions in zones of 5 km, 30 km, and 100 km radius around the Saga proposed nuclear power plant site near Porsgrunn in the Outer Oslofjord are briefly discussed and presented in tables and maps. A prognosis of the population trends to the year 2000 is also discussed and presented in tables and maps. (JIW)

29654 (TID-26728) POPULATION NUMBERS, FEEDING BEHAVIOR, AND THE ECOLOGICAL IMPORTANCE OF SEA OTTERS IN THE WESTERN ALEUTIAN ISLANDS, ALASKA. Estes, J. A. (Arizona Univ., Tucson (USA)). [nd]. 140p. Dep. NTIS $10.00.

Thesis.

The role of sea otters in the dynamics and structure of nearshore communities was studied from October 1970 to November 1972 at Amchitka Island, Attu Island, and Shemya Island, western Aleutian Islands, Alaska. Data are presented on the size and the amount of time budgeted to feeding, resting, and grooming of a sea otter population which is near equilibrium density, and to evaluate the ecological importance of sea otter predation in the nearshore community. The number of sea otters at Amchitka Island was estimated by comparing shore-based and aerial counts within specific segments of coastlines and extrapolating these results to the entire coastline. (auth)

29655 CONTINUOUS MONITORING OF CHLORIDE AND FLUORIDE IONS BY ORION ELECTRODES IN SURFACE AND GROUND WATER. Berthier, P. (CEA Centre de Pierrelatte, 26 (France)). Analusis; 2: No. 10, 722-728(Nov 1974). (In French).

A study was made of the continuous monitoring of chlorides and fluorides in surface and ground water at Pierrelatte. The following problems were studied: electrode calibration; the possible interference of chemicals; the apparatus and the difficulties of the continuous monitoring. A technique was developed that enables chloride concentrations between 3.5 mg/l and 35 g/l and fluoride concentrations between 20 μg/l and 20 g/l to be measured. (FR)

Thermal Effluents

Refer also to abstract 32220.

29656 (CONF-750205-1) RESPONSES OF BASS TO NATURAL AND ARTIFICIAL TEMPERATURE REGIMES. Coutant, C. C. (Oak Ridge National Lab., Tenn. (USA)). 1975. 51p. Dep. NTIS $4.00.

From national bass symposium; Tulsa, Oklahoma, USA (3 Feb 1975).

Data are summarized from a study of the responses of the centrarchid basses to water temperature. The temperature requirements for reproduction and growth of largemouth bass (micropterus salmoides) and smallmouth bass (m. dolomieuii) are given. The effects of thermal effluents from nuclear or fossil-fuel power plants on the population dynamics of these fish species is considered. (CH)

29657 (NOAA-TM-ERL-ARL-47) WASTE HEAT DISPOSAL FROM NUCLEAR POWER PLANTS. Rotty, R. M. (National Oceanic and Atmospheric Administration, Silver Spring, Md. (USA). Air Resources Lab.). Sep 1974. 27p.

For more than a century, the global consumption of energy has been growing exponentially at a rate of 5.4 percent per year. In accord with the second law of thermodynamics all electrical power generation cycles must reject heat, and as larger and larger amounts of electricity are needed larger amounts of heat must be rejected. The quantity of reject heat is rapidly approaching a level at which its impact on the atmosphere cannot be neglected. Possible intensification of convective activity and associated concentration of vorticity may be caused by concentrating large amounts of heat rejection in small areas. The type of cooling employed at a given power generation site has a major effect on the heat flux per unit of area. The use of once-through cooling spreads the heat added to the atmosphere over a wide surface area. The use of artificial ponds, lakes, or canals is next most effective in spreading the heat addition over largest possible areas; evaporative cooling towers, wet/dry, and dry cooling towers concentrate the heat added in comparatively small surface areas. Once-through cooling is recommended for use wherever possible for the cooling of power plants. Smaller units and single-unit sites should be considered so that better advantage can be taken of the once-through capacity that may be available. Cooling systems having once-through cooling in combination with cooling towers are possibilities deserving careful investigation. (auth)

29658 (PB-232226) PROCESS CONTROL MODEL FOR OXYGEN REGENERATION OF POLLUTED RIVERS, PHASES IV AND V, AND SPATIALLY AND TEMPORALLY DISTRIBUTED DISCHARGE OF EFFLUENTS IN ESTUARIES. Completion Report. Davidson, B. (Rutgers-The State Univ., New Brunswick, N. J. (USA). Water Resources Research Inst.). Jan 1974. Con-

tract DI-14-01-0001-3616; OWRR-B-045-NJ(1). 16p. (W-74-07837). NTIS $3.00.

The report very briefly describes an intra-tidal-time, deterministic, one-dimensional, non-isothermal, multi-state-variable, water quality model for the upper Delaware River estuary system between Trenton and Wilmington. The unique features of the proposed model are associated with its time and space scales, which are of the order of 30 minutes and one mile, respectively, and its simultaneous state equation format, which included an ad hoc tidal velocity equation and conservation balances on dissolved oxygen, BOD, and thermal energy. Numerical routines using central differences for the space derivatives in combination with a fourth-order, Runge-Kutta expression for the time derivatives provided stable and accurate results for the integration of the system equations. (GRA)

29659 (PB-235833) THERMAL EFFECTS OF A NUCLEAR POWER PLANT ON THE MISSISSIPPI RIVER AT MONTICELLO, MINNESOTA. Hopwood, A. J. (Minnesota Univ., Minneapolis (USA)). Jul 1974. Contract DI-14-31-0001-3097. 150p. (WRRC-BULL-69). NTIS $5.75.

The thermal effects of the nuclear power plant at Monticello, Minnesota were assessed by comparing postoperational (1971-1972) data to baseline data (1968-1971) on the Mississippi River. Macroinvertebrate samples from artificial substrates placed upstream were compared to those from the heated zone downstream. Trichopteran biomass increased, ephemeropterans and dipterans decreased in the heated zone. Significant responses to heated water were observed from trichoptera in the July–October period. Ephemeroptera were most affected in the May–August period. Dipterans declined significantly during September through November. The number of species was not affected by the heat. Growth rates of macroinvertebrate groups in upstream and downstream areas were not significantly different in four of seven 35-day cycles observed. A comparison of the number of fish caught by electro-fishing along the opposite sides of the river showed that black crappies, smallmouth bass, and walleyes were more numerous on the heated side. (GRA)

29660 EFFECTS OF THERMAL EFFLUENT ON THE AMERICAN OYSTER, CRASSOSTREA VIRGINICA GMELIN, IN INDIAN RIVER BAY, DELAWARE. Tinsman, J.; Maurer, D. Newark, DE; Univ. of Delaware (1974). 118p. $3.00.

In June 1970, 2025 oysters (Crassostrea virginica) were divided among three stations in Indian River Bay: at the intake of the Delmarva Power and Light Co., 2.5 km downstream at the mouth of the effluent canal, and at a station 6 km east of the plant at Oak Orchard. High mortalities necessitated placement of 6600 additional oysters in July at the same three stations. These were sampled from August 1970 to May 1971. The heated effluent had the effect of shortening and modifying the severity of the winter, thereby increasing the growing season. Oysters in the effluent showed the greatest shell growth throughout the study. Meat weights and glycogen concentration in the effluent were highest of all the stations in the winter. Summer conditions in the effluent were severe due to excessively high temperatures and meat weights and glycogen concentrations were lower than at other stations. In the spring, spawning may have occurred prematurely in the effluent at Station Two. The study showed that the thermal effluent has both beneficial and detrimental effects depending on the season. (auth)

29661 TEMPERATURE INFLUENCE ON BACTERIAL POPULATIONS IN THREE AQUATIC SYSTEMS. Cherry, D. S. (Clemson Univ., SC); Guthrie, R. K.; Harvey, R. S. Water Res.; 8: 149-155(1974).

Effects of temperature changes on bacterial populations in three aquatic systems were studied in the Thermal Effects Laboratory of the USAEC's Savannah River Laboratory. At monthly intervals for 12 months, total plate counts and diversity of heterotrophic, mesophilic bacteria were determined from a natural stream, two artificial streams, and two outdoor ponds. Water for artificial systems was drawn from the natural stream. Effects of changes in ambient temperature were analyzed in natural and artificial streams and in an unheated pond. A second pond was heated above natural stream temperature. Temperature elevation resulted in increased total plate counts in each system. Bacterial diversity increased in all systems during the initial 3 to 4°C increase in temperature. However, a reduction in diversity occurred when temperature was maintained 4 to 10°C above the initial ambient temperature. Changes were observed in both nutritional types and genera. (auth)

29662 HYDRAULICS OF DISCHARGE OF WARM DRAINAGE INTO DEEP LAYER. Onishi, S. (Electric Power Development Co. Ltd., Tokyo (Japan)). Dengen Kaihatsu K. K., Chosa Shiryo; No. 2, 48-71(Mar 1974). (In Japanese).

The present status of studies on the discharge of warm water plumes is reviewed. The plume is classified into vertical plume and horizontal plume. There are four regions in which the plume flow shows peculiar characteristics. The region I is a region close to the exit part of the plume, the region II is an established flow region, the region III and IV are regions of forming surface flow. The distributions of velocity and density of flow in the region II are analyzed, and the results are shown for the vertical and the horizontal plumes. The behavior of the vertical plume near surface is described. The flow in associated flow-in region of surface flow, the flow in homogeneous flow region and the thickness of the surface flow are analyzed. Other topics introduced in this paper are discharge by a porous diffuser and the vertical plume in the flow region in which density varies linearly. Velocity of flow and the distribution of density of plume, associated flow-in of cold water around discharging port, associated flow-in of cold water far from the discharging port, associated flow-in in circular plume in uniform transverse flow, and the plume in the region having the linear distribution of density are discussed as the characteristics of the vertical plume. (JA)

Chemical Effluents

Refer also to abstracts 28996, 29667, and 32357.

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 29605, 29959, 31768, and 32323.

29663 (AED-CONF-74-509-021) CALIBRATION OF LARGE-VOLUME NEUTRON DETECTORS USING THERMAL NEUTRONS WITH ISOTROPIC AND UNIDIRECTIONAL INCIDENCE. Matzke, M. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany)). 1974. 8p. (In German). INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract.

Using the example of the calibration of a cylindrical dose value measurement (neutron rem counter), the irradiation equipment is described and the measuring methods are given which are used in the PTB with large-volume detectors of thermal neutrons. The detectors in the graphite nucleus of the flux density standard I of the PTB are calibrated in a cavity for quasiisotropic incidence of thermal neutrons. The counter rate of thermal neutrons is determined by the difference of the counter rates of two irradiations with and without cadmium covering of the detector. The flux density of thermal neutrons on various points of the surface of the detector is determined from the saturation activities of simultaneously irradiated gold foils which are put on the surface of the detector. For unidirectional incidence of thermal neutrons, the detectors to be calibrated are calibrated point-by-point with and without cadmium covering with a well bundled beam of neutrons in front of the beam tube S1 of the FMRB. The counter rate is determined by numerical integration which is produced in a wide parallel bundle with irradiation. The measured results obtained on a rem counter according to both calibration methods are compared with the results of other authors. (auth)

29664 (ANL-CT-74-45824-0009) SUMMARY OF TEST RESULTS FROM EXPERIMENT NI-2 FOR THE RSN-286, S/N M402 AND THE WX-31384, S/N 703902 FISSION COUNTER-CHAMBERS BEING TESTED IN THE EBR-II NITF J-2 THIMBLE AT 800°F. Reactor Run 67 (November 1973) thru Run 68 (January 1974). Yingling, G. E. (Argonne National Lab., Ill. (USA)). 1 Dec 1974. Contract W-31-109-Eng-38. 61p. AT.

A summary of test results from the testing of two fission counter-chambers in the EBR-II J-2 thimble of the Nuclear Instrument Test Facility (NITF) is presented. The two fission counter-chambers being tested as Experiment NI-2 are a Reuter-Stokes Model RSN-286, S/N M402, and a Westinghouse Model WX-31384, S/N 703902. This report covers the experiment test temperature increase from 700 to 800°F in November 1973, Reactor Runs 67 and 68, and the following shutdown until the experiment test temperature was increased to 900°F in January 1974. (auth)

29665 (CONF-741213-17) IMAGING EFFICIENCY OF Ge AND NaI(Tl) GAMMA-RAY DETECTORS. Strauss, M. G.; Sherman, I. S. (Argonne National Lab., Ill. (USA)). [nd]. 23p. Dep. NTIS $4.25.

From nuclear science symposium; Washington, District of Columbia, USA (11 Dec 1974).

A figure of merit is derived for the efficiency with which a detector images a γ-ray emitting object using the signal-to-noise ratio as the criterion. Photons scattered in the detector that ultimately culminate in photoelectric absorption produce an undesirable background when imaging with position-sensitive detectors as in cameras. When imaging with detectors that are not position sensitive as in scanners, these photons contribute to the image of the object. In comparison with NaI(Tl), Ge detectors have lower photoelectric efficiency and higher detector scatter. However, these are offset by much higher energy resolution and the consequent near complete tissue-scatter rejection. As a result, the imaging efficiency for a brain phantom at 150 keV is shown to be comparable for Ge and NaI(Tl) cameras. In the case of scanners, the imaging efficiency of Ge was calculated to be 40 to 75% higher for a brain phantom with a one γ-ray emitting radionuclide such as ^{99m}Tc, and effectively 2 to 2.5 times higher for a three γ-ray emitting radionuclide such as ^{67}Ga. The imaging efficiency, which depends on absorption characteristics and energy resolution, is a measure of the total performance of the detector. It is shown that in addition to being useful for comparing different types of detectors, this figure of merit also provides means for optimizing imaging parameters such as detector thickness. (auth)

29666 (CONF-750303-9) ABSOLUTE CALIBRATION OF NEUTRON DETECTORS IN THE 10–30 MEV RANGE. Cookson, J. A.; Hussian, M.; Uttley, C. A.; Fowler, J. L.; Schwartz, R. B. (Oak Ridge National Lab., Tenn. (USA); National Bureau of Standards, Washington, D. C. (USA); UKAEA Research Group, Harwell. Atomic Energy Research Establishment). [nd]. 3p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A central problem in fast neutron research is that of finding the absolute efficiency of neutron detectors. Using the associated particle method for this purpose, we have designed a chamber to count He particles from the D(d,n)^{3}He or the T(d,n)^{4}He reaction in coincidence with neutron events. The reactions take place in deuterium or tritium gas and a ΔE solid state counter at 80°, 65°, or 43° to the 2 to 10 MeV deuteron beam direction detects the He particles with 100% efficiency. To reduce background we allow the deuterons to pass out of the gas chamber through a Ni window and stop the beam ~150 cm from the counters. With the D(d,n)^{3}He reaction we have obtained ~2% efficiency calibration of the central portion of a liquid scintillator in the 9 to 10 MeV energy range. With the T(d,n) reaction this calibration can be extended to ~27 MeV and the efficiency can be mapped out as a function of position in the scintillator. (auth)

29667 (CONF-750304-1) MICROPROCESSOR-CONTROLLED WATER-POLLUTION MONITORING SYSTEM. Roberts, M. J. (Oak Ridge National Lab., Tenn. (USA)). 1975. 8p. Dep. NTIS $4.00.

From conference on industrial applications of microprocessors; Philadelphia, Pennsylvania, USA (11 Mar 1975).

A water-quality monitor was designed and built to sample water flowing over a weir in White Oak Creek near the Oak Ridge National Laboratory (ORNL). ORNL is required to sample the water at regular volume intervals to determine whether it meets federal water-quality standards. Because the monitor must yield a high accuracy (0.1%) in measuring water-volume and high repeatability (0.1%) of sample size and demonstrate long-term stability (low-drift), a digital control system using a microprocessor was developed to replace the analog controller in an existing monitor. (auth)

29668 (FMI-1000-585) QUANTITATIVE EVALUATION OF HUMAN VISUAL DETECTION PERFORMANCE USING EMPIRICAL RECEIVER OPERATING CHARACTERISTIC CURVES. Metz, C. E.; Goodenough, D. J. (Chicago Univ., Ill. (USA). Dept. of Radiology). [nd]. 30p. (CONF-730687-2). Dep. NTIS (US Sales Only) $4.50.

From 3rd international conference on data handling and image processing in scintigraphy; Cambridge, Massachusetts, USA (6 Jun 1973).

A basic problem in scintigraphy which will become increasingly important as new imaging devices and new image processing techniques are introduced is that of objectively evaluating any given imaging procedure in terms that will permit meaningful comparison of procedures. Since the clinical usefulness of any scintigraphic image depends upon the ability of human observers to extract information from it, and since the relationship between physical parameters of an image and the ability of human observers to perceive features in the image is not at all clear at present, meaningful conclusions regarding the relative quality of images produced by two procedures can only be decided empirically by measuring the ability of human observers to reach correct decisions after viewing the images. A method of observer performance analysis originally introduced in the field of radar detection and now common in psychophysics is measurement of a "Receiver Operating Characteristic (ROC) Curve," which is essentially a plot of the conditional probability of true positive decisions regarding the presence or absence of a "signal" in the visual field (i.e., probability of a positive response given that a signal is present) versus the conditional probability of false positive decisions (i.e., probability of a positive response given that no signal is present) as the observer's "detection threshold" or degree of conservatism in calling a questionable situation positive is varied. The use of ROC curves for evaluation of human observer performance was studied. (WHK)

29669 (HEDL-TME-75-16) EFFECTS OF GAS PRESSURE AND PREAMPLIFIER CONFIGURATION ON NEUTRON FISSION CHAMBER PERFORMANCE FOR COUNTING AND MSV OPERATION. Philipp, L. D.; Meiss, J. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1974. Contract AT(45-1)-2170. 43p. Dep. NTIS $4.00.

Counting and Mean Square Voltage (MSV) data were taken for three neutron measurement channels: (1) a charge sensitive,

(2) a current sensitive with integration, and (3) a current sensitive plus a charge sensitive system. The effects of changing gas pressure on neutron and gamma sensitivity for each system were measured. Pressure changes for improving performance were discussed. Current sensitive systems can replace charge sensitive systems for many reactor applications without loss of sensitivity. For FFTF, 1.75 atmospheres fill gas pressure for the ex-vessel detectors will allow the system to meet specification of greater than 10^{-10} $\langle v^2 \rangle$/nv. (auth)

29670 (LBL-2846) EFFECT OF TEMPERATURE ON THE LATENT TRACK FADING RATE OF AgCl (CADMIUM DOPED) CRYSTAL DETECTORS. McGinnis, J.; Cassou, R.; Benton, E. V.; Budinger, T.; Moyer, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1975. Contract W-7405-eng-48. 14p. Dep. NTIS $4.00.

In order to determine the effect of temperature on the latent track fading rate, qualitative observations were made on tracks with stabilization lag times (the time between exposure and stabilization during which the tracks fade) of 0 and 20 minutes. Charged particle tracks in AgCl (cadmium doped) detectors incubated at 40°C prior, during, and after exposure to 350 MeV/amu neon ions were compared to tracks in AgCl(Cd) detectors kept at 22°C. Also, two groups of AgCl(Cd) detectors were exposed to 5.5 MeV alpha particles under various incubation conditions and stabilization lag times of up to 120 minutes. The comparison of neon track quality for 40°C to those at 22°C, and the comparison among the alpha exposures indicate that there is little or no difference in the latent track fading rate between crystals at 22°C and those at 40°C. (auth)

29671 (RT/FI-(74)40) RIGOROUS EXPRESSION FOR THE VARIANCE OF NEUTRON COUNTS FROM THE FORWARD AND BACKWARD KOLMOGOROV EQUATIONS. Arcipiani, B.; Marseguerra, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Oct 1974. 38p. Dep. NTIS (US Sales Only) $5.00.

With the Kolmogorov "forward" and "backward" equations of branching stochastic processes as a starting point, calculations are performed which lead to a rigorous expression for the reduced variance of the number of neutrons counted in a fixed time interval by a detector placed in a subcritical multiplying system with source. No assumption concerning the emission of prompt neutrons and precursors in a fission event is made. (auth)

29672 (SC-RR-67-855) COMPTON DIODES: THEORY AND CONJECTURES. Kelly, J. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1968. Contract AT(29-1)-789. 62p. Dep. NTIS $6.25.

The theory of Compton diode gamma radiation detectors is discussed in detail in a more general manner than has previously been published, with special attention given to diodes filled with perfect dielectrics. Specifically the emphasis is on the correlation of the Compton currents generated in the device with the charge currents in a grounded signal lead. A simplified discussion of space charge, breakdown, barrier effect, and conductivity current problems in real dielectrics is also presented along with some suggested design improvements. (auth)

29673 (UCRL-76269) PROGNOSIS FOR HIGH-Z SEMICONDUCTOR DETECTORS. Swierkowski, S. P.; Armantrout, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Dec 1974. 8p. (CONF-741213-18). Dep. NTIS $4.00.

From nuclear science symposium; Washington, District of Columbia, USA (11 Dec 1974).

Considerable interest has been generated recently in the use of high-Z semiconductors for x-ray spectroscopy. To aid in this study, a Monte-Carlo computational model has been used to simulate x-ray spectral response in semiconductor detectors. The model employs one-dimensional charge collection in an arbitrary electric field profile and includes trapping and electronics system effects. Spectra are calculated for several materials, including HgI_2 and CdTe, and are compared to experimental results. (auth)

29674 THIN-FILM BREAKDOWN COUNTER OF FISSION FRAGMENTS. Tommasino, L. (Comitato Nazionale per l'Energia Nucleare, Roma, Italy); Klein, N.; Solomon, P. J. Appl. Phys. 46: No. 4, 1484-1488 (Apr 1975).

A new kind of detector of heavy fission fragments is described. The detector is a thin-film capacitor in which electrical breakdowns are nonshorting. The detection is based on the counting of breakdowns which arise when heavy fission fragments hit the capacitor. These breakdowns occur at fields distinctly lower than those due to the application of the field only. The lowering of the breakdown field is discussed considering the thermal or electronic effects for silicon dioxide detectors. The detectors offer immediate information on the magnitude of particle fluxes and may possibly serve to identify the particles. (auth)

29675 SEMICONDUCTOR POSITION SENSITIVE DETECTOR. Garin, A.; Waase, B. (to CEA, 75-Paris (France)). French Patent 2,184,535/A/. 19 May 1972. 10p. (In French).

A method for manufacturing semiconductor position sensitive detectors comprising a plate having a front surface and a rear surface is discussed. Said method comprising the steps of carrying out in said rear surface of said plate of doped semiconducting material forming the detector, through a thin metal layer deposited on said rear surface, an ion bombardment providing a doping of the same type as that of the plate, of thermally annealing that plate and of depositing at least two metal contacts on the rear surface. (FR)

29676 A METHOD AND DEVICE FOR THE DETECTION OF SAFETY MAXIMUM PERMISSIBLE DOSES FOR THE PROTECTION AGAINST CASUALTIES ARISING FROM RADIOACTIVITY. Le Breton, J.; Prigent, R.; Renard, C. (to CEA, 75-Paris (France)). French Patent 2,184,399/A/. 15 May 1972. 8p. (In French).

This device is characterized in that it comprises a probe forming a scintillation-counter, the scintillator of which comprises two members viz. a plastic scintillator sensitive to gamma rays preferentially and a slow neutron sensitive scintillator both surrounded by a speed-reducing sleeve, on the one hand, and a resistor-capacitor circuit associated with said probe, on the other hand. Any overriding of the safety limit dose being signaled by said resistor-capacitor circuit, whereas an overriding of the dose rates is signaled by the resistor of said circuit, exclusively the capacitor, being disconnected. This device is used in an alarm-signaling arrangement applying the so-called "two-out-of-three" type. (FR)

29677 A NEW INSTALLED NUCLEONIC MODULAR RADIATION AND CONTAMINATION MONITORING SYSTEM. Dray, C. H. C.; Shepherd, J. A. (Nuclear Enterprises Ltd., Reading (UK)). pp 569-588 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

With the increase in the number of nuclear power stations, radioisotope production units and research laboratories throughout the world, it has become necessary to take a fresh look at instrumentation for monitoring nuclear radiation and contamination hazards. The hazards that require monitoring fall into two main groups: controlled or accidental exposure to gamma or neutron radiation, controlled or accidental contamination of liquid or gaseous effluents by radioactive products. In an effort to provide adequate monitoring facilities which can if necessary be interrogated and controlled by computers, a modular installed monitoring system has been developed. The system described includes a series of remote sealed detector assemblies using Geiger Mueller tubes fitted with energy compensating filters for low and medium levels of gamma radiation; ionization chamber detectors for medium and high levels of gamma radiation; scintillation counter detectors for alpha, gamma and iodine vapour effluent contamination: double concentric gamma compensated ionisation chamber detectors for the measurement of beta emitting radioactive gases in air; and continuous aerosol detectors for the measurement of release of radioactive particulate material on a moving filter paper in ventilation systems and exhaust stacks. The detector assemblies each contain their own electronic units on standard printed circuit boards. These operate from 12 volt D.C. supplies and produce a D.C. analogue output signal proportional to the logarithm of the radiation level. This is fed back to either a local control panel or central control console, for visual indication of the hazard and actuation of alarms which may be set to readings corresponding to any analog signal from 0 to -5 volts. (FR)

29678 A PORTABLE ALPHA-PARTICLE DETECTOR. Chapuis, A. M.; Dajlevic, Danielle. (to CEA, 75-Paris (France)). French Patent 2,192,316/A/. 13 Jul 1972. 7p. (In French).

Between an alpha-radiation source and an alpha-particle detector are mounted at least two collimators associated to screens of unequal thicknesses by means of which alpha-particles of different energies can be separately detected. The invention can be applied to the measurement of radon concentrations, in particular in uranium mines. (FR)

29679 SELF-POWERED NEUTRON DETECTORS. Verdant, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 3-6(Sep 1974). (In French).

These detectors are designed for continuous neutron flux measurements in reactors and possess the originality of working without external electric polarization. They are diodes with one

of the electrodes generating electrons proportionately to neutron captures and are similar in size and technology to the thermocouples used in reactors. The emitting electrode may be of rhodium, silver, vanadium, cobalt or platinum. The work of the Saclay Electronic Services are briefly described. The chief application of collectrons concerns the core monitoring of power reactors. (FR)

29680 LIQUID XENON DETECTORS. Lansiart, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 194, 25-31(Jul 1974). (In French).

The various uses of liquid detectors are reviewed. They can be used as scintillators, charge collectors, or proportional counters. In this last case it is also possible to have photon multiplication without electron multiplication. In scintillation counting their advantage is to give a signal 25 times shorter than NaI(Tl). They have been used for fine localization of charged particles (mean quadratic spacing of 15 microns). Energy resolution during gamma absorption was studied together with the improvement of the purity of xenon. Owing to the low mean energy for electron production (17 eV) it is hoped to reach energy resolutions close to those supplied by semiconductors. It is possible to think in terms of building detectors of a kilogram or more. (FR)

29681 LOW-COST, PORTABLE SYSTEM FOR THE MEASUREMENT OF $^{14}CO_2$ IN GAS STREAMS. Swan, A. G.; Rawson, H. M. (CSIRO, Canberra, Australia). Photosynthetica (Prague); 7: No. 4, 325-329(Dec 1973).

The construction of a solid-state, portable instrument for the measurement of $^{14}CO_2$ in gas streams is described. The use of Geiger-Mueller counters, simple electronic circuitry and inexpensive components ensures reliability at very low cost. The instrument has adequate sensitivity for gas counting at levels of $^{14}CO_2$ commonly used in translocation and photosynthesis experiments. (Nucl. Sci. Abstr. Czech.)

29682 OPTIMIZATION OF RADIOIODINE DETECTOR WORKING PARAMETERS. Moravek, J.; Hladky, E. (Vyskumny Ustav Energeticky, Jaslovske Bohunice, Czech.). Radioisotopy; 16: No. 1, 63-89(1975). (In Czech).

A method for optimization of radioiodine detector working parameters in gaseous exhausts of nuclear power plants and for maintaining a high selectivity of radioiodine detection in the presence of great excess of gaseous fission products, namely xenon, is described. The effect of radioiodine accumulation by suitable filters on the suppression of excess xenon is discussed. (auth)

29683 EQUIPMENT. Boyd, C. M.; Lane, J. M.; Dalrymple, G. V.; Baker, M. L.; Nash, J. C. (Univ. of Arkansas, Little Rock). pp 198-242 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

Equipment for clinical nuclear medicine was studied. Scintillation counting, digital equipment applications, pulse height spectrometry, determinants and evaluation of system performance, and photographic films are discussed. (WHK)

29684 RECONSTRUCTION OF THE FRESNEL-CODED GAMMA CAMERA IMAGES BY DIGITAL COMPUTER. Budinger, T. F.; Macdonald, B. (Univ. of California, Berkeley). J. Nucl. Med.; 16: No. 4, 309-313(Apr 1975).

An algorithm for the digital reconstruction of the Fresnel-coded gamma camera image consists of the spatial Fourier transform of the hologram after applying a quadratic phase shift. Background subtraction is implemented by use of positive and negative zone plates. Tomographic planes are reconstructed in 27 sec from a single zone-plate shadow image by successively varying a parameter in the reconstruction algorithm on a small computer system. (auth)

29685 DEADTIME CHARACTERISTICS OF ANGER CAMERAS. Sorenson, J. A. (Univ. of Utah, Salt Lake City). J. Nucl. Med.; 16: No. 4, 284-288(Apr 1975).

The deadtime characteristics of Anger cameras are analyzed from theoretical and experimental points of view. An investigation of two Searle radiographics cameras revealed that they had both paralyzable and nonparalyzable components, the deadtimes of which varied with analyzer window width, the energy of the gamma rays counted, and the position of the "time constant selector" switch in the A-scope module of these cameras. A mathematical model for two-component systems is presented. (auth)

29686 APPLICATION OF ANNIHILATION COINCIDENCE DETECTION TO TRANSAXIAL RECONSTRUCTION TOMOGRAPHY. Phelps, M. E.; Hoffman, E. J.; Mullani, N. A.; Ter-Pogossian, M. M. (Washington Univ., St. Louis). J. Nucl. Med.; 16: No. 3, 210-224(Mar 1975).

A study was carried out to investigate the use of annihilation coincidence detection (ACD) in emission transaxial reconstruction tomography. The ACD was evaluated in terms of spatial resolution and sensitivity with depth, detection efficiency, effect of pulse-height analysis on resolution and efficiency, correction for attenuation, and cold spot contrast. A prototype positron emission transaxial tomograph (PETT) consisting of a hexagonal array of 24 NaI (Tl) detectors employing ACD was constructed. A fast Fourier transform algorithm was employed to generate the reconstructed image. Computer simulations and phantom and animal studies were carried out to demonstrate that this approach yields tomographic radionuclide images that have high resolution and contrast (hot and cold spot) and that are independent of activity above and below the plane examined. The ACD yields a quantitative nuclear medicine imaging device with high detection efficiency. Comparisons are presented between the ACD and the scintillation camera and scanner. Discussion of the possible applications of the PETT in nuclear medicine is included. (auth)

29687 COMPONENT RESOLUTION INDICES FOR SCINTILLATION CAMERA SYSTEMS. Brookeman, V. A. (Univ. of Florida, Gainesville). J. Nucl. Med.; 16: No. 3, 228-230(Mar 1975).

From published overall resolution indices for three Anger camera systems, measured with three straight-bore collimators and ^{99m}Tc in air and with a water absorber present, the components due to inherent camera resolution, collimator geometry, and scatter are derived at various depths. Replacement of S-11 multiplier phototubes by bialkali phototubes improves calculated inherent Pho/Gamma III camera resolution by about 30% and by a further 33% upgrading to a high-performance model. At distances 2, 5, 8, and 10 cm from each collimator face with an intervening water absorber, mean scatter components of overall resolution indices are 6, 8, 9, and 10 mm, respectively. In typical clinical ^{99m}Tc imaging situations with a scattering medium present, the relative contributions of camera, collimator, and scatter to the total overall system resolution are presented. (auth)

29688 RADIATION AND THERMAL TESTS OF ELECTRON-EMISSIVE NEUTRON DETECTORS AND CABLES WITH MAGNESIAL INSULATION. Emel'yanov, I. Ya.; Vlasov, V. I.; Volod'ko, Yu. I.; Karpechko, S. G.; Konstantinov, L. V.; Postnikov, V. V.; Uvarov, V. I. Sov. At. Energy (Engl. Transl.); 37: No. 1, 756-761(Jul 1974).

Translated from At. Energ.; 37: No. 1, 72-76(Jul 1974).

Four electron-emissive neutron detectors with a silver emitter were tested in the IVV-2 reactor, representing a section of KDMS(S) cable, made to technical specifications TUMI 098-69. The cable has a core of silver Sr 999 GOST 7222-54 with a diameter of 0.55 mm, magnesium oxide insulation, analytical grade GOST 4526-67 and is clad with corrosion-resistant steel Kh18N10T with a thickness of 0.5 mm; the external diameter of the cable is 3.0 mm. In addition, four samples of KNMS(S) cable, to technical specifications TU15-06-467-69, were tested. The material of the core and cladding was corrosion-resistant steel Kh18N10T and the insulation material was fused magnesium oxide, periclase electrotechnically in accordance with GOST 13236-67. The diameter of the core was 0.5 mm, cladding thickness 0.6 mm and the external diameter of the cable was 3.0 mm. The EDN and cable samples, before testing, were outgassed for 7 h at a temperature of 750 to 800°C. Results of the tests are presented and discussed. (WHK)

29689 COMPARISON OF KNOWN METHODS OF LOGARITHMIC PULSE RATE MEASUREMENT. Pilz, R. (Technische Hochschule, Magdeburg, Ger.). Isotopenpraxis; 10: No. 11-12, 391-396(1974). (In German).

Following an explanation of the term "logarithmic pulse rate measurement," the characteristic values of integrating circuits having logarithmic characteristics, such as logarithmic error, range, solution time and statistical error, are described. The main portion of the paper is dedicated to the description of the possibilities to perform logarithmic pulse rate measurements, taking into consideration the essential particularities and economic aspects of the different versions. Measured values compiled in tables render possible comparison of the methods. (auth)

29690 COMPUTERS IN SCINTIGRAPHY. Yasukochi, H.; Machida, K.; Sugawara, T.; Ohshima, M.; Kumura, F. (Tokyo Univ. (Japan). Faculty of Medicine). Gendai No Shinryo.; 16: No. 5, 735-747(May 1974). (In Japanese).

This paper reviews the data processing of scintigrams by computer. The scintigram is processed by smoothing and enhancement. These scintigrams are analyzed by measurement of area, detection of uniform distribution, and recognition of form and function. Diagnosis is made from these analyzed scintigrams and the results are filed and indexed. (JA)

29691 HIGH RESOLUTION BULK-SAMPLE COUNTER WITH VARIABLE GEOMETRY. Cronquist, A. G.; Mackenzie, J.; Smith, T. (University Coll. Hospital Medical School, London). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 89-91(Feb 1975).

A sensitive detector which is also capable of a high degree of spectral resolution and of low-energy γ-ray detection which can be used for the counting of multiple bulk samples is described. The system consists of twin NaI crystal detectors with variable geometry so that sample containers up to the size of a Winchester bottle can be accommodated. The counting sensitivities for various radionuclides in 2 litre volumes are tabulated. The relative efficiencies of counting point and uniform sources of ^{125}I, ^{51}Cr, and ^{59}Fe in 200 and 400 ml volumes using photopeak and wide-band counting are shown. The detectors were set at minimum separation and three different counting methods were used; outputs of both detectors added, geometric mean of individual detectors, and upper detector only. Normally the technique of adding the detector outputs is used. It is shown that the system can be used for counting ^{42}K samples ranging from 10 nCi to 400 μCi accurately. (UK)

29692 COMPARISON OF PROPORTIONAL COUNTER GASES WITH RESPECT TO SPURIOUS PULSE PRODUCTION. Campion, P. J.; Burke, M. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 79-85(Feb 1975).

The probability, θ, of a spurious pulse or pulses following a genuine pulse initiated by a single electron has been measured at 720 and 60 torr for the following counter gases: methane, propane, ethylene, tissue equivalent gas and a mixture of 90% argon and 10% methane. The measured values of θ varied considerably from gas to gas and were, in general, smaller for the lower operating pressure. At the voltage required to detect single electrons very large values were observed for θ for radiations from ^{55}Fe and ^{241}Am. It was also noted that, even in circumstances in which θ is much less than unity, there is a significant probability that some pulses will produce more than one spurious pulse. (auth)

29693 DIGITAL ANALYSER FOR SCINTIGRAM FROM PAPER TAPE. Yasukochi, H.; Ishikawa, D. (Tokyo Univ. (Japan). Faculty of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 4, 220-228(Apr 1974). (In Japanese).

The informations from scintigrams are best available from photoscintigrams. However, the addition of digital information will improve the diagnostic accuracy in any cases. For this purpose, computer treatment and color display are proposed, but they have disadvantages of high cost or of nonlinear information transfers. To make digital scintigrams from recorded data in paper tape, we have constructed one apparatus and experienced for six years discarding the handicaps noted above. The details of the apparatus and the experiences are reported. (WHK)

29694 HIGH-RESOLUTION NEUTRON CAMERA FOR DIFFRACTION EXPERIMENTS. Stinson, R. H. (Univ. of Guelph, Ont.); Egelstaff, P. A.; Holden, T. M. Can. J. Phys.; 53: No. 1, 52-57(1 Jan 1975).

An area detector for thermal neutrons which uses track etch techniques was designed and tested. Neutrons are captured in a ^6Li foil and emergent α particles and tritons are recorded in a cellulose nitrate film. High spatial resolution is achieved, although the detection efficiency for 1 Å neutrons is small. (auth)

29695 EXPERIMENT OF SEMI-CONDUCTOR NEUTRON DETECTOR. Takahashi, S.; Hoshino, S. (Tokyo Univ. (Japan). Inst. for Solid State Physics). Kakuriken Kenkyu Hokoku; 6: No. 2, 293-297(Dec 1973). (In Japanese).

Semiconductor neutron detectors differ in structure from other semi-conductor radiation detectors, but are nearly equal to them in advantages and disadvantages. An experiment was carried out on a surface-barrier type which collects the charge of α-particles due to the $^6Li(n,\alpha)$ reaction with silicon semiconductor. Since the detection efficiency, linearity and stability were studied in the JRR-2 and JRR-3 reactors, the experiment on energy dependence and the γ-ray effect was conducted with a LINAC source. The neutron detector is a disc of 3.0 cm diameter and 0.5 cm thickness. Measurement of incoherent scattering of neutrons from a vanadium sample was performed in parallel, fixing the detector and an existing ^3He counter at the same angle. The similar spectra to that of a BF_3 counter has been obtained by measuring the Bragg reflection of a graphite single crystal of fairly high reflectivity. The incoherent scattering spectrum for the semiconductor detector was different from that for the ^3He counter. Neutron conversion materials of these two detectors are ^3He and ^6Li. The reaction cross sections of both materials in relation to neutron energy vary exponentially. Therefore it is difficult to understand that they showed different characteristics. (JA)

29696 GaAs BIOMEDICAL SEMICONDUCTOR DETECTORS. Kobayashi, T.; Sugita, T.; Takayanagi, S. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan). Research and Development Center); Sasaki, Y.; Basugi, N. Radioisotopes (Tokyo); 23: No. 8, 432-436(Aug 174). (In Japanese).

A set of GaAs medical probes for in vivo measurement of β and γ-ray emitting radioactive elements has been fabricated from high purity gallium arsenide materials. GaAs surface barrier diode is used as a radiation senser and three diode structure shapes, such as side window, coaxial and frontal window structures are fabricated. The noise performance of the probe was less than 18 keV at room temperature. Some of the probes had good counting efficiency for both β and γ-ray emitting radioisotopes and also good energy resolution for low energy γ-rays. Fundamental probe characteristics have been studied by using various kinds of RIs, such as ^{32}P, ^{85}Kr, ^{57}Co, ^{99m}Tc, and ^{133}Xe at both room temperature and body temperature. The applications of probe in medicine are considered. (auth)

29697 A SEMICONDUCTOR DETECTOR AND TELEMETRY SYSTEM FOR IN VIVO RI MEASUREMENT. Kobayashi, T.; Sugita, T.; Sasaki, T. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan). Research and Development Center); Iwase, T.; Sassa, R. Radioisotopes (Tokyo); 23: No. 8, 437-442 (Aug 1974). (In Japanese).

A silicon radiation detector and biomedical telemetry system has been developed and used in the study of the function of organs of free ranging animals. The system consisted of an implantable silicon radiation detector, a transmitter, FM receiver, and data handling unit. The intensity of radioisotopes (RI) taken in the organs is measured continuously with an implantable probe with a 5 mm diameter sensitive area. The prototype transmitter package, which consists of an RI signal conditioner, and a transmitter, is made of aluminium $2 \times 6 \times 9.5$ cm^3 in size. With electronic components included, it weighs 170 g. The power consumption of the transmitter is about 100 mW, and is furnished from three 5 V mercury batteries. The fundamental characteristics and field performance of the system were carried out using several dogs with the aid of radioisotopes. The applications in medicine are discussed. (auth)

29698 SPATIAL RESOLUTION OF GAMMA CAMERA AND EFFECT OF SCATTERED RADIATION. Matsumoto, M. (Kumamoto Univ. (Japan). School of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 4, 229-238(Apr 1974). (In Japanese).

Potential resolution of the delay-line gamma camera (TOSHIBA, GCA-102) and effect of scattered radiation by absorbing substance on the resolution were studied. The resolution of ^{99m}Tc with a 4000 hole collimator was the best. The resolution distance (FWHM) of ^{99m}Tc obtained with the 4000 hole collimator were 8.4 mm on the surface of collimator and 11.9 mm at the distance of 10 cm between source and collimator in the X-direction, and 7.8 mm and 11.6 mm in the Y-direction respectively. Similarly, as to ^{203}Hg, the FWHM were 8.2, 13.2, 7.0, and 13.0 mm, respectively. The FWHM of ^{198}Au by the use of the 1000 hole collimator at the distance of 5, 10, and 20 cm were 14, 18, and 26 mm in the X-direction, and 13, 17, and 26 mm in the Y-direction. When the absorbing substance was placed between the source and collimator face, the resolution fell off by the effect of scattered radiation. The ratios of the FWHM in the absorber of 5 cm thickness to the one in the air were 1.15, 1.13, 1.07, and 1.04 for the 40, 30, 20, and 10% photopeak window, respectively. (auth)

29699 MASS SPECTROSCOPIC STUDY OF ALPHA-RAY TRACKS IN METAL. Aratani, M. (Institute of Physics and Chemical Research, Wako, Saitama (Japan)). Bunseki Kiki; 12: No. 4, 217-223(Apr 1974). (In Japanese).

The method of detecting alpha-ray tracks by mass-spectroscopic method was investigated. It was considered that ions were produced along a path of alpha-ray. A mass spectrometer was designed to extract and to analyze produced ions. A type of the ion source used for the study was a sputter ion source. The used alpha-ray sources were ^{241}Am and ^{210}Po. The ions produced along the tracks in samples by the action of alpha-ray were extracted by an electric field. The deflection angle of the analyzing part of the spectrometer was 90°, and the radius of orbit was 200 mm. The detection of analyzed ions was performed with an electron multiplier with associated electronic circuits. The first electrode of the multiplier was a 16 stage copper–beryllium electrode. The relative intensity of observed ion peaks as the function of thickness of medium was obtained for the layers of gold. Seven peaks were observed for a layer of 3 μ thick, and those corresponded to gold ions from +2 to +8. No peak was observed for the layers of 9 μ thick. This thickness corresponds to nearly same length as the average range of alpha particles in gold. The phenomena due to δ ray were not observed, and it was concluded that the primary particles producing ions in gold were mainly alpha particles. The method of treating a solid as stacked foil for analysis was investigated. The ionization in dielectric substances were discussed. (JA)

Radiation Dosimeters

Refer also to abstract 29886.

29700 LITHIUM FLUORIDE CONTAINING THERMO-PHOSPHOR. Druskina, L. S.; Shaver, I. K. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). French Patent 2,190,896/A/. 22 Jun 1973. 11p. (In French).

A thermoluminophore was developed with a tissue-equivalent lithium fluoride base. It contains, in addition to the lithium fluoride, up to 0.1 wt % Ce and up to 3 wt % Ca. Various thermo-excitation curves are given. The applications include controlled individual dosimetry and radiobiological studies. (FR)

29701 ASSESSMENT OF MEASUREMENT ERRORS IN THE USE OF DIFFERENT DOSIMETRIC SYSTEMS. Stavitskii, R. V. Med. Radiol.; 20: No. 2, 50-54(Feb 1975). (In Russian).

The measurement errors inherent in the use of dosimetric systems based on NaI(Tl), AgBr photographic film, photoluminescence phosphate glass, and thermoluminescent LiF were evaluated. The energy dependence of the four types of detectors was determined. The energy spectra of γ radiation from ^{60}Co and bremsstrahlung in air and in tissue equivalent medium are shown, and the self-scattering for the four types of detectors was evaluated. The results show the impossibility of using detectors prepared from inorganic materials for clinical dosimetry because of the lack of tissue equivalence. (JSR)

29702 UV MEASUREMENT BY BeO AND LiF THERMOLUMINESCENCE. Bassi, P.; Busouli, G.; Lembo, L.; Rimondi, O. (CNEN, Bologna). G. Fis. Sanit. Prot. Radiaz.; 18: No. 4, 137-142(1974). (In Italian).

UV transferred thermoluminescence in BeO and LiF (TLD-100) preirradiated with gamma radiations were studied. The response of the detectors as a function of the uv exposure from a germicidal lamp (λ = 2537 Å) at several gamma pre-doses was measured. In addition, the intrinsic sensitivity to uv and common light was determined. On the basis of the experimental results, it can be stated that these detectors are useful to measure uv exposure in biomedical and industrial applications. (auth)

29703 INTERCOMPARISON OF HIGH ENERGY RADIATION DOSIMETRY IN JAPAN, 1. Preliminary Intercomparison of High Energy Electron Dosimetry. Shiragai, A.; Hoshino, K.; Kato, Y.; Yashizume, T. (National Inst. of Radiological Sciences, Chiba (Japan)); Antoku, S. Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 9, 422-427(Jun 1974). (In Japanese).

An intercomparison of high energy electron dosimetry was attempted in early 1972, by using mailed LiF-TLD. LiF-TLDs prepared in the National Institute of Radiological Sciences (NIRS) and Hiroshima University (HU) were mailed and withdrawn together by NIRS. Institutions in Japan were randomly selected in this preliminary intercomparison. The institutions that showed absorbed dose were only three, and in the other institutions the irradiated doses were shown in terms of "exposure." Therefore the irradiated doses were calculated by using the values absorbed dose conversion factor C_E in ICRU Report 21. The water or water-equivalent phantoms were used in the five institutions and in the other institutions lucite phantoms were used. The absorbed doses of water in lucite phantoms were calculated approximately by deducing a conversion equation of C_E for water in lucite. The standard deviation of TLD measurements for each institution was less than or about ±2% except for a few institutions. The dose estimations in NIRS and HU agreed nearly within the error in intercomparison by using mailed LiF-TLD. The absorbed doses in two institutions were very small, i.e., about 80 and 40% of those in NIRS and HU. As to the intercomparison among the three institutions that showed the absorbed doses, the standard deviation of the absorbed doses was about ±2% with agreement of the estimations in NIRS and HU. (auth)

29704 INTERCOMPARISON OF HIGH ENERGY RADIATION DOSIMETRY IN JAPAN, 2. Intercomparison of JAPM Sub-Standard Dosimeters and Absorbed Dose for High Energy Electrons. Shiragai, A.; Kato, Y.; Hashizume, T. (National Inst. of Radiological Sciences, Chiba (Japan)). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 6, 428-432(Jun 1974). (In Japanese).

To unify the absorbed dose for ^{60}Co γ-rays in radiotherapy, JAPM sub-standard dosimeters have been installed in eleven district centers since 1971. An intercomparison of JAPM dosimeters was attempted, in early 1972, by using mailed LiF-TLD. LiF-TLDs were irradiated in water or water-equivalent phantoms by using ^{60}Co teletherapy units. The standard deviation of the absorbed doses was ±2.8%. The absorbed doses given at three centers deviated appreciably from the ones at other centers. The two of these three centers do not possess a checking source yet. For the other center, which possesses the checking source, comparison was repeated after re-calibration of the JAPM dosimeter. It resulted in the same value as in the first intercomparison. The absorbed dose for high energy electrons was also compared in early 1972 by using mailed LiF-TLD. Absorbed doses were estimated at eleven institutions. The standard deviation of the mean value was ±3%. The mean values of absorbed dose conversion factors used at each institution were 0.890 and 0.833 at 2 cm depth in water for 10 and 20 MeV electrons, respectively. These values are in good agreement with the values given in ICRU Report 21. (auth)

29705 EXTENSION OF RANGE OF FILM DOSIMETRY BY X-RAY FLUORESCENCE TECHNIQUE. Gangadharan, P.; Negi, B. S.; Murthy, B. K. S.; Mukherjee, R. (Bhabha Atomic Research Centre, Bombay). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 49-52 (Feb 1975).

This paper describes the studies carried out on the application of x-ray fluorescence technique for the evaluation of intense γ exposures recorded by personnel monitoring films. Measurements were done on Kodak Type-2 and Agfa Gevaert personnel monitoring films using a ^{210}Pb source for exciting silver K x-rays and a compact electronic unit consisting of a power supply, amplifier, single-channel analyzer and scaler. A palladium absorption filter was employed to cut off photons of energy higher than those of silver K x-rays. Selecting suitable films, exposures of the order of 3000 R which cannot be evaluated by normal optical density measurements, could be evaluated with a standard deviation of ±5%. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 30422.

29706 (ANU-P-487(3)) COMPUTER REDUCTION OF COMPLEX SPECTRA. Ophel, T. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Oct 1974. 90p. Dep. NTIS (US Sales Only) $7.50.

The problems of on-line and off-line computer analysis of complex spectra, with particular reference to particle and gamma ray spectra, are summarized. Details are given of an integrated set of on-line and off-line analysis programs for use with the 1800, and of a universal program for the S360/50 and U1108, INCRED, which incorporates all of the features of the 1800 programs and employs both linear and nonlinear fitting techniques. The programs are intended to perform all the basic reduction functions usually required and are structured so that modifications or additions to meet particular user requirements are readily made. The final section discusses line shape fitting of gamma ray spectra obtained with NaI and Ge(Li) detectors in the context of programs intended for use on the 1800, the S360/50 and the U1108. (auth)

29707 (EURFNR-1197) PROTON RECOIL SPECTROMETER FOR IN-PILE MEASUREMENTS IN THE ENERGY RANGE BETWEEN 500 keV AND 3 MeV. Korthaus, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Jun 1974. Translation of KFK-1994. 29p. Dep. NTIS $4.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A proton recoil spectrometer for in-pile measurements of neutron spectra between 500 keV and 3 MeV in fast zero energy assemblies is described. It uses a spherical ionization chamber filled with methane at 11 atmospheres and works at a high voltage of 12 kV. Test measurements with monoenergetic neutrons have revealed an energy resolution of 10%. Results of measurements on a ^{252}Cf-spontaneous fission neutron source and a ^{241}Am/F-(α,n)-source as well as measurements in the SUAK assembly 7A are in good agreement with results of other authors. (auth)

29708 (UCRL-Trans-10821) RESPONSE OF A Kr-FILLED ^{3}He PROPORTIONAL COUNTER. Shirakata, K.; Mukaiyama, T.; Iijima, T. (Kyoto Univ. (Japan)). 15 Mar 1971. Translated from pp. 94-100 of KURRI-TR-89. 12p. Dep. NTIS $4.00.

Measurement of the neutron spectrum with the ^{3}He proportional counter used in the FCA fast critical assembly at JAERI is limited to the energy range from around 20 keV to 2 MeV. The upper limit of the application range is determined mainly by the increase in the counter's wall effect in the region of higher energies. A new He-3 counter, filled with Kr gas, has been introduced to raise the upper limit of the application range. The counter's obtained responses to monoenergetic neutrons are used to measure the neutron spectrum in the FCA assembly. Measurements of the neutron spectrum up to 5 MeV agree well with the calculated values. (auth)

29709 (UCRL-Trans-10825) NEUTRON DETECTOR FOR SPECTROMETRIC STUDIES. Doil'nitsyn, E. Ya.; Stupak, A. I.

(Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1975. Translated from Neutron Physics. Part II. 8p. Dep. NTIS $4.00.

A neutron detector for time-of-flight measurements is described. The detector consists of an absorber comprising a mixture of Eu, Sm, Er and Hf with a hydrogenous moderator, and of NaI crystals for recording the capture cascade gamma rays. (auth)

29710 (UCRL-Trans-10826) MEASURING FAST-NEUTRON SPECTRA WITH A RECOIL-PROTON PROPORTIONAL COUNTER. Ichimori, T.; Obu, M.; Shirakata, K. (Kyoto Univ. (Japan)). 15 Mar 1971. Translated from pp. 80-86 of KURRI-TR-89. 15p. Dep. NTIS $4.00.

The characteristics of a small proportional counter are studied. Field tubes of the hypodermic-needle type are compared with insulated ceramic ones and are found inadequate for use with low gas multiplication. The monochromatic-neutron response indicates that gas-multiplication saturation commences at a count of around 2×10^5 electrons collected per pulse by the anode wire in small counters 15 to 20 mm in diameter. At an energy of some 5 keV, about 90% of the gamma events can be eliminated electronically by the neutron-gamma discriminating system. For spectrum measurements at lower energies, a lead shield has to be used. When the response characteristic is determined experimentally, the sensitive volume is dependent on the energy of the incident neutrons from dead regions. Hence integration of the response function, expressed as a probability, is not normalized to unity. (auth)

29711 LARGE ANGULAR APERTURE X-RAY SPECTROMETER. Sahores, J.; Larribau, E. (to Societe Nationale des Petroles d'Aquitaine (SNPA), 92 – Courbevoie (France)). French Patent 2,188,839/D/. 8 Jun 1972. 15p. (In French).

A high-brightness x-ray spectrometer is described. Its main feature lies in using an irradiation tube adapted to emit slow electrons, which makes it possible to resort to an appropriate cathode and anode arrangement and to magnetic or electrostatic means acting on the electron beam, whereby the sample is irradiated along a narrow band acting itself as a rectilinear x-ray source. The main application of the invention consists in obtaining a higher photocount per unit-time with the same energy input, whereby it is possible either to lower the detection threshold, or, by reducing the duration of counts, to increase the analysis rate. (FR)

29712 ENERGY ANALYZER FOR RESOLUTION OF AN ELECTRON BEAM INTO ELECTRON BEAM BUNDLES OF HOMOGENEOUS ENERGY. Mathams, R. F. (to Associated Electrical Industries Ltd., London (UK)). German(FRG) Patent 1,498,543/C/. 9 Aug 1973. 6p. (In German).

The energy analyzer for electron beams and beams of other charge and mass homogeneous particles is a magnetic spectrometer. The energy particle beam to be analyzed enters perpendicular to the lines of force and in the direction of constant field strength distribution in a monotonic decreasing inhomogeneous magnetic field of variable average field strength (with gradient perpendicular to the original beam direction), which by means of suitable polarity, deflects the beam particles firstly in a region of increasing field strength. Only particles having the standard energy exactly describe a complete trochoid trajectory circle up to the exit of the field and leave the field with their original course of direction on the entrance axis through a slit of variable width. The pole-shoes of the electromagnets leave in pole pieces with even field-limited surfaces inclined to one another and with variable angles of inclination. Because of the alignment to the entering and exiting axis of the standard particles, the analyzer can be used as monochromator in the beam trajectory of electron optical systems (electron microscope). Functional and technical particulars are presented in detail. (GE)

29713 SILICON SPECTROMETER WITH A PELTIER REFRIGERATOR. Belcarz, E.; Chwaszczewska, J.; Hahn, G.; Nowicki, W.; Sawicka, B.; Skoczek, K.; Slapa, M.; Szymczak, M. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 19: No. 12, 1057-1067(1974).

A spectrometer with a Si(Li) detector cooled by a Peltier refrigerator is described. The spectrometer is able to analyze samples of practically all of the most frequently encountered emitters of alpha, beta, and low-energy gamma radiation. The energy resolution was about 1.3 to 1.5 keV for 14-keV gamma radiation. The system can also operate in field conditions for fluorescence analysis. (auth)

29714 ULTRA HIGH PURITY Ge GAMMA-RAY DETECTORS. Kobayashi, T.; Sugita, T.; Sasaki, T.; Matsuo, N. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan). Research and Development Center). Radioisotopes (Tokyo); 23: No. 8, 427-431 (Aug 1974). (In Japanese).

A planar detector with a depletion layer width 5 mm has been fabricated from p-type ultra-high-purity germanium ($N = 7 \times 10^9$/cm^3 at 77 K) purchased from Hoboken (Belgium). n+ and p+ layers were fabricated by using Li diffusion at 350°C and ion implantation of boron at room temperature, respectively. A simplified cooling assembly suitable for an ultra high purity Ge detector has been studied. In this assembly, the encapsulated detector is mounted on a copper rod cooled by immersion in liquid nitrogen. It is covered with polystyrene foam thermal insulation to avoid heat losses and frosting-up of the electrical connection to the detector. The best energy resolution of 15 mm^2 × 5 mm Ge detector with the aid of this assembly were 2.3 keV (FWHM) and 4.6 keV (FW 1/10 M) for ^{57}Co γ-rays, respectively. (auth)

29715 PROGRAM FOR ON-LINE DATA COLLECTION IN NEUTRON SCATTERING EXPERIMENTS. Niimura, N.; Watanabe, N. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science); Tomiyoshi, S.; Yamada, Y.; Ozora, A. Kakuriken Kenkyu Hokoku; 6: No. 2, 319-327(Dec 1973). (In Japanese).

In the neutron generating equipment installed in the 300 MeV LINAC in Tohoku University, beam holes have been increased to eight. Since this enabled simultaneous experiments by many groups, the time-of-flight analyzer of 64 inputs has been assembled. The on-line program for this analyzer has also been written. Data processing is practiced with control panels and push buttons on CRT display panels. Data transmission is divided into systems of 4K words each. This is the range controllable by a control panel and a CRT panel. Data of each system is divided into 8 groups, and every group has four areas respectively in a magnetic drum. The feature of this program is that the system is adopted in which break-in into CPU is carried out by the operation of the control and CRT panels and the break-in processing routine identifies each operation and returns after setting flags for the required routine and the master program jumps at the flag of each required routine. The required practising routines include 11 instructions. (JA)

29716 PRECISE MEASUREMENT OF THE CONVERSION ELECTRONS WITH THE INS BETA-RAY SPECTROMETER. Kawakami, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). pp 111-112 of Nuclear Spectroscopy. Proceedings of the Symposium at Wako, Saitama, Japan, 10 March 1972. Wako, Saitama, Japan; Institute of Physical and Chemical Research (1973). (In Japanese).

From symposium on nuclear spectroscopy; Wako, Saitama, Japan (10 Mar 1972).

29717 METHOD CONCERNING THE MEASURING OF THE ENERGY DISTRIBUTION OF IONIZING RADIATION. (to Philips Gloeilampenfabrieken N. V.). Netherlands Patent 7,110,516. 30 Jul 1971. 19p. (In Dutch).

The invention deals with a new spectrometer of the analysis of ionizing radiation energy distribution. The radiation is fed to a radiation counter, that converts the radiation quanta into electric impulses. A charge-sensitive amplifier converts the contents into a step signal, the step height of which is determined by integrating the output signal from the amplifier both before and after time t_p, when the impulse is generated, and by subtracting the result of integration before the time t_p from the result of integration after this moment. The detector has a more favorable signal-to-noise ratio than hitherto known. (NL)

29718 CONCENTRIC RING TECHNIQUE FOR THE MEASUREMENT OF FAST NEUTRON FLUXES AND ENERGIES. Jarjis, R. A.; Hunt, S. E. (Aston Univ., Birmingham, Eng.). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 57-60(Feb 1975).

The limitations imposed by fixed foil, mixed powder and sandwich foil techniques for fast neutron flux measurements led the authors previously to suggest a concentric ring monitoring technique. This technique can be extended to measure neutron energies if excitation functions of the two materials are known. The method is verified by using concentric copper monitoring rings with aluminum discs. The ratios of activities of copper and aluminium enable the neutron energy to be measured to ±1.2%. The advantages and applications of the technique are discussed and a modified design is suggested for very short target to specimen separation. An antimony disc with concentric copper and aluminium rings was used to measure the ^{121}Sb(n,2n)^{120g}Sb excitation function, the copper and aluminium rings being used to measure both fast neutron flux and energy. It is suggested that the ^{121}Sb(n,2n)^{120g}Sb reaction would be very useful as a standard for flux monitoring in the 14 MeV region since its excitation function is relatively flat between 13.5 and 15 MeV. (auth)

29719 MASS SPECTROMETER AUTOMATION AND DIGITIZATION FOR ISOTOPE-GEOLOGICAL INVESTIGATIONS. Dijkstra,

N.; Gans, R. (Laboratorium voor Isotopen-Geologie, Amsterdam). Radio Electronica; 23: 769-773(Dec 1974). (In Dutch).

An introduction is given comprising the principles of age determination in geology using radioactivity, and of mass spectrometers. The flow diagram for an automated version of the Varian-Mat GD 150 gas mass spectrometer at Amsterdam is given as well as detailed drawings of the electric circuitry. It offers the possibility of selecting and measuring a maximum of seven masses. The mass selector with its channel-setting circuit and the program counting procedure are described. A time sequence diagram of the integration timer is given. (NL)

High Energy Physics Instrumentation

29720 (BNL-19671) SOME NEW DEVELOPMENTS ON TRANSITION RADIATION DETECTORS FOR HIGH-ENERGY PARTICLES. Yuan, L. C. L. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 20p. (CONF-7410104-1). Dep. NTIS $4.00.

From ESRO workshop; Frascati, Italy (24 Oct 1974).

Some of the basic characteristics and new developments in transition radiation detectors for detection and identification of high-energy particles in cosmic ray and high-energy physics are reviewed. (WHK)

29721 (COO-3071-114) LARGE AREA MAGNETIC SPECTROMETER FOR THE STUDY OF HIGH ENERGY NEUTRINO INTERACTIONS. Benvenuti, A.; Cline, D.; Mann, A. K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1974. 16p. Dep. NTIS $4.00.

The design, construction, and performance of a large solid iron magnetic spectrometer which has been used to identify and measure the momentum of muons produced by interactions of neutrinos with nucleons are described. The rms momentum resolution varies from 10 to 15 percent between 5 and 150 GeV/c. (auth)

29722 (COO-3071-115) LIQUID-SCINTILLATOR TOTAL ABSORPTION HADRON CALORIMETER FOR THE STUDY OF NEUTRINO INTERACTIONS. Benvenuti, A.; Cline, D.; Mann, A. K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1974. 32p. Dep. NTIS $4.75.

The performance of a large-volume liquid-scintillator calorimeter which has been used to measure the total energy of hadrons produced by interactions of neutrinos with nucleons is described. The resolution of the calorimeter is about 12% rms for incident pions over the energy range 20 to 150 GeV, and about 15% for neutrino-induced hadron systems in the chosen fiducial volume after corrections for imperfect energy containment. (auth)

29723 (LBL-3653) JUBB: RECOGNIZING PARTICLE TRACKS IN CYLINDRICAL SPARK CHAMBERS. Fourt, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1975. Contract W-7405-eng-48. 22p. Dep. NTIS $4.00.

JUBB is the collective name for a group of Fortran routines that recognize tracks traveling through cylindrical spark chambers. It has been written specifically for the SPEAR Magnetic Detector Experiment SP1, but with a considerable degree of generality, so that it may be readily used in other, similar situations. It uses only space coordinates, and does not take into account information coming out of other parts of the detector, i.e., the shower counters, muon chambers, etc. It does geometrical reconstruction exclusively. JUBB is described in a very idealized fashion, abstracting the algorithms and the intentions from the grubby matrix of the actual SP1 data analysis program and the physical detector. The general problem that JUBB must deal with is outlined, and then the data structures are described that JUBB sets up and manipulates, which is to say that the information JUBB receives and produces and the method by which it is passed on for further analysis is described. Finally, the algorithms JUBB uses for recognizing tracks are described. (auth)

29724 (LNF-73-56) 180° MAGNETIC SPECTROMETER WITH HELIUM FILLED STREAMER CHAMBER. Balestra, F.; Busso, L.; Carfagnini, R.; Piragino, G.; Barbini, R.; Guaraldo, C.; Scrimaglio, R.; Falomkin, I. V.; Klyukin, M. M.; Shcherbakov, Yu. A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 27 Sep 1973. 16p. INIS.

The experimental apparatus exposed to the LNF-LEALE pion beam to measure the large angle pion-nucleus scattering is described. This 180° spectrometer consists of a streamer chamber filled with helium at atmospheric pressure, placed in a magnetic field, and used for identification of scattering events. The required degree of localization and brightness of the tracks is obtained without using a Blumlein transmission line. Finally, the momentum resolution obtainable with this spectrometer has been evaluated by a Monte Carlo technique. (INIS)

29725 (RL-74-075) DESIGN CONSIDERATIONS FOR A RAPID CYCLING BUBBLE CHAMBER SUITABLE FOR OPERATION AT THE CERN SPS. Diplock, B. R.; Turner, W.; Williams, P. R. (Science Research Council, Chilton (UK). Rutherford Lab.). May 1974. 7p. Dep. NTIS (US Sales Only) $4.00.

Consideration is given to the factors which are either fixed or are highly desirable in the design of a rapid cycling bubble chamber for use with the SPS. Three geometries are discussed. The arguments on optical resolution are set out. (UK)

29726 (RL-74-091) ARGONNE-CERN-RUTHERFORD TST COLLABORATION REPORT OF TESTS, MAY 1974. Foster, J. H.; Fitzharris, E. W. (Science Research Council, Chilton (UK). Rutherford Lab.). Jun 1974. 3p. Dep. NTIS (US Sales Only) $4.00.

During the last two weeks in May the second part of this collaboration, i.e., filling the 12' Argonne Bubble Chamber with a uniform H_2-Ne mixture was attempted. The mixture aimed for was 35 mol % Ne. The results are described. Arrangements were made for beam (6 GeV/c polarized protons) to be available at the chamber and data were taken at two different temperature settings, 12°K pix at 29°K and 9°K pix at 28.2°K. Good pictures were obtained. (auth)

29727 (RL-75-007) GAS MONITORING UNIT FOR MULTIWIRE PROPORTIONAL CHAMBERS. Marsh, J. B.; Boon, J. E.; Souten, K. H.; O'Hagan, B. (Science Research Council, Chilton (UK). Rutherford Lab.). Nov 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

A description is given of a method of constant monitoring for "magic gas" mixtures used in multiwire proportional chambers. (auth)

Radiometric Instruments

Refer also to abstract 30798.

29728 USE OF NEUTRON BACKSCATTERING IN MEASURING THE THICKNESS OF HEAVY MATERIALS. Pekarskii, G. Sh.; Efimov, P. V. (Inst. of Scientific-Research for Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestruct. Test. (Eng. Transl.); 10: No. 3, 373-374(1974).

Translated from Defektokopiya; 10: No. 3, 143-144(1974).

The use of neutron backscattering for measuring the thickness of materials of high atomic weight when the specimen can be reached from only one side is compared with the gamma technique. The materials investigated were Al, Fe, and Pb. (TFD)

29729 A METHOD AND DEVICE FOR MECHANICALLY MODULATING A FLUX OF PARTICLES. Edeline, J. C.; Lavergne, J. (to CEA, 75-Paris (France)). French Patent 2,184,533/A/. 19 May 1972. 11p. (In French).

This device is characterized in that it comprises a plate carrying regularly spaced particle-emitting sources alternated with non-emitting, or dummy, sources and means for driving said plate and causing said sources to come alternately and periodically in register with a member adapted to be impinged by a modulated flux of particles, the composition of said dummy sources being such that, in the course of their motion, they generate a spurious flux of the same type as that generated by the emitting sources but phase-shifted by a half-period. This device is used in solution content meters using gamma radiation absorption. (FR)

29730 MEASUREMENT OF THE BORON CONCENTRATION OF WATER. Dumesnil, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 49-53(Sep 1974). (In French).

The method is based on the measurement of the thermal flux created in the water by an isotopic neutron source. The mock-up includes a CPNB 20 boron-coated counter placed in the axis of a 5.5 cm^3 cylinder containing the solution to be analyzed, and a 100 mCi AmBe source in contact with the detector. This unit is placed in the middle of a water-filled vessel (volume about 120 cm^3) serving as reflector. The geometry was calculated to reduce the analysis volume to a minimum. The probable error on the measurement is 5.2 ppm natural boron for a concentration of 1000 ppm and a count of 100s. (FR)

29731 COMPARISON OF TWO TYPES OF SCINTILLATION PROBE FOR MOISTURE DENSITY GAUGE. Machaj, B. (Inst. of Nuclear Research, Warsaw). Nukleonika; 19: No. 12, 1069-1079 (1974).

Investigations of a pulse shape discrimination scintillation probe, and an amplitude discrimination probe as a detector for a moisture density gage were carried out. It was found that

sandwich scintillators consisting of NE-421 + NE-102A was the best for the pulse shape discrimination probe for thermal neutrons and gamma radiation detection. Similarly a LiI(Eu) crystal was the best for the amplitude discrimination probe. The amplitude discrimination probe with LiI(Eu) when compared to the pulse shape discrimination probe with a sandwich scintillator, provides approximately two times more thermal neutrons detection efficiency and a higher count rate stability. It is considered therefore to be more suitable as the detector for use in a moisture density gage. (auth)

29732 RADIOACTIVE ISOTOPE SENSOR DEVICE. Pozdnikov, V. N.; Sazonov, O. L.; Taksar, I. M. British Patent 1,373,789/B/. 6 Nov 1974. Filed date 10 Aug 1972. 9p.

Reference is made to radioactive isotope sensor devices used in the control and automation of technological processes. The device described may be used to provide a sensor responsive to the levels of liquid and bulk materials in containers of various shapes. It may also be used to provide a sensor responsive to the positions and displacements of objects, including parts of mechanisms and means of transportation. Another use is for determining changes in the density of a fluid. The device has a high speed of operation and a high statistical reliability. Full details are given of the construction and mode of operation. (UK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 29574, 30108, 30128, 30339, 31889, 31890, and 31989.

29733 (HMI-B-159) EFFECT OF IONIZING IRRADIATION UPON THE SURFACE PROPERTIES OF STANDARD TECHNOLOGY MOS-STRUCTURE. Kaempf, U. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Porz-Wahn (F. R. Germany). Inst. fuer Angewandte Gasdynamik). Dec 1974. 147p. (In German). Dep. NTIS (US Sales Only) $10.50.

Thesis.

The influence of different preparation conditions and the effect of ionizing radiation upon oxide charges and interface states in thermal oxidized MOS varactors were examined. The correlation of these two quantities before and after x-ray irradiation (150 keV, 10^4 rad) is shown. The correspondence between experiments and calculations on the basis of a Schottky-diode-model shows that the radiation induced oxide charge exists near the metal-and the semiconductor-electrode in the SiO_2 as well. (auth)

29734 (TID/SNA-775) SUPPLEMENT TO s110-XCE01-W181: RADIATION EFFECTS ON ELECTRONICS. Preliminary Guidelines for Designing Electronics for Operation in a Radiation Environment. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1969. 208p. Dep. NTIS $13.50.

Data and information are presented on radiation hardening of electronic systems against nuclear radiation, neutron damage constants for bipolar transistors, radiation effects on semiconductor devices, and the use of computers to analyze the effects of nuclear radiation on circuits and systems. (JRD)

29735 (TID/SNA-812) REQUIREMENTS FOR TESTS OF EFFECTS OF GAMMA RADIATION ON ELECTRONICS. Test 28A001B (Rev 0) PMOS NOR Gate (Ambient). Test 28A002B (Rev 0) PMOS NOR Gate (LN_2). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1971. 45p. Dep. NTIS $5.25.

This document describes the effort for active-static, ambient, and liquid-nitrogen temperature test No. 28A 001B "Gamma Radiation Effects on PMOS Type NOR Gates." It provides the basis for generation of detailed test procedures, design and procurement of test fixtures and equipment, execution of the test, acquisition of data, and reporting of results. The units to be tested are metal-oxide-semiconductor field-effect type integrated circuits. (DLC)

29736 (TID/SNA-1161) 23/W103 RESISTANCE TEMPERATURE TRANSDUCERS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1963. 47p. Dep. NTIS $5.50.

Preliminary results of the irradiation test on resistance thermometers, conducted at the Plum Brook Reactor Facility in Sandusky, Ohio, on September 5–September 8, 1963, are described. The purpose of the experiment was to obtain operational data on the NRX-A candidate transducers in a high dose rate radiation environment. (auth)

29737 (TID/SNA-1319) CLEVITE CORPORATION PIEZOELECTRIC ACCELEROMETER MODEL 25D21-X, PRE-IRRADIATION ANALYSIS. Fluke, G. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Apr 1964. 27p. Dep. NTIS $4.50.

Clevite Corporation piezoelectric accelerometer, Model 25D21-X, was analyzed for its expected performance in a radiation field. It was estimated that it can withstand integrated dosages of 10^{17} fast n/cm^2 and 7×10^{10} ergs/gm(C). The radiation intensities are fixed by the temperature limitations of the accelerometer (300°F for accuracy limitations and 500°F for component limitations) and the means by which heat can be dissipated from the internal parts. Conduction to cold surfaces and convective cooling are considered as means of heat dissipation. Fields up to 3×10^{10} ergs/gm(C)-hr (0.83 watts/gm) are considered. Cooling is specified for steady-state conditions so that the period of operation in a field of this intensity is determined by the integrated dosage limitations. (auth)

29738 (TID/SNA-1331) TUNGSTEN-RHENIUM THERMOCOUPLE PERFORMANCE IN GTR-13 TEST. Fluke, G. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Jul 1964. 17p. Dep. NTIS $4.00.

Two tungsten-rhenium thermocouples, a W-W/26% Re model manufactured by Auto-Control Lab and a W/5% Re-W/26% Re Aerojet model manufactured by Aero-Research, were irradiated in GTR Test No. 13. The test was conducted for one-hundred hours. The approximate neutron fluxes were 8×10^{11} and 2×10^{12} n/cm^2-sec for fast and thermal neutrons, respectively. The gamma field was about 10^9 ergs/gm(C)-hr. The W/5% Re-W/26% Re thermocouple malfunctioned (severe rise in millivolt output) 18.8 hours after the beginning of the test. Subsequent readings (the thermocouple completed the test) were erratic in that they fluctuated over a range of millivolt outputs. The W-W/26% Re thermocouple withstood the test although it showed a gradual decline in output throughout the test which exceeded the computed neutron effects. (auth)

29739 (TID/SNA-1344) ELECTRICAL IRRADIATION TEST 23/L501 PRESSURE TRANSDUCERS. Volume II. Final Test Report. Robb, T. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Apr 1964. 22p. Dep. NTIS $4.25.

One Dynisco, two Consolidated Electrodynamics Corp., seven Statham, and eight Gianinni pressure transducers were tested on the ground test reactor (GTR) for 100 hr during the period October 24–29, 1963. Eleven pressure transducers were irradiation tested, and seven were tested in a nonirradiation environment as control units. Neutron- and gamma-integrated doses were measured during the test, and transducer output voltages were recorded at intervals throughout the test. The low data accuracy of the data acquisition system precluded any qualitative analysis for effects of gamma heating and dose rates. No significant transducer material degradation was noted during the test. (auth)

29740 (UCRL-51746) LATE-TIME ELECTROMAGNETIC COUPLING TO POWER LINES. Landt, J. A.; Deadrick, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Feb 1975. Contract W-7405-Eng-48. 20p. Dep. NTIS $4.00.

The problem of Nuclear EMP coupling to power lines, with particular emphasis on late-time response (times on the order of 1 ms) is examined. A time-domain approach is used to find the energy collected by the power lines. Peak current estimates are obtained for power lines in free-space, with catenary sag, and in proximity to perfect and finitely conducting grounds. (auth)

29741 SOS TECHNOLOGY FOR MOS INTEGRATED CIRCUITS. Bernard, J.; Borel, J.; Garcia, M.; Suat, J. P. Bull. Inform. Sci. Tech. (Paris); No. 194, 63-72(Jul 1974). (In French).

Standard MOS technologies limitations are reviewed: speed limitations, technological yield, radiation hardening. Specific advantages of SOS technology in these various fields are given. Particular limitations are related to the small volume of the silicon available for device integration. Substrate contamination of the silicon layer is studied. Electrical properties of the layers are alterated defects (leakage currents, carriers mobilities). Results obtained at LETI in this field are presented. (FR)

29742 EFFECT OF NANOSECOND X-RAY PULSES FROM THE HIGH-POWER ELECTRON ACCELERATOR ON PHOTOELECTRON MULTIPLIERS. Semin, B. N.; Shkatov, V. T.; Akerman, S. G. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 117-118(1974). (In Russian).

The reaction of photomultipliers to nsec x radiation and the relaxation of luminescence appearing in alkali halide crystals exposed to pulsed high-power electron irradiation were studied. The x-ray pulse was superposed on the luminescence pulse, and it is necessary to separate these pulses to determine the effect of the x radiation. The results showed that the effect of the x radiation is shown in the form of two pulses. The first directly affects the dynode of the photomultiplier and the second the cathode. Lead shielding is necessary to eliminate the effects of the x radiation on the photomultiplier. (JSR)

29743 LATTICE DEFECTS AND HUMP CURRENT IN ELECTRON IRRADIATED GaSb TUNNEL DIODE. Arizumi, T.; Yoshida, A.; Kutsuna, I. (Toyoda Physical and Chemical Research Inst., Nagoya (Japan)). Toyoda Kenkyu Hokoku; No. 6, 56-60(Mar 1973). (In Japanese).

From the studies of the hump current characteristics produced in the 2 MeV electron irradiated GaSb tunnel diodes were investigated the lattice defects in the GaSb crystals. The defect level has been estimated from the hump current centered at ~270 mV, yielding the level of Ev + 0.15 eV. This defect has the reverse annealing characteristic in the temperature range above ~90°K. The hump never disappears up to 200°C. It is concluded that the concerned defect may not be simple (such as a single Ga or Sb vacancy) but rather complex. (auth)

Miscellaneous Instruments

Refer also to abstracts 29885, 30039, 30046, 30325, 31474, 31773, 31808, and 32246.

29744 (CEA-N-1769) STUDY AND DEVELOPMENT OF XY PLOTTER COUPLED WITH A COMPUTER FOR EXPERIMENTS IN NUCLEAR PHYSICS. Libourel, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de la Metrologie et de la Physique Neutroniques Fondamentales). Dec 1974. 97p. (In French). Dep. NTIS (US Sales Only) $8.00.

Thesis.

An apparatus is described that may be used as an incremental plotter to plot curves resulting from nuclear physics experiments. It is driven by a computer, the function of which is in first priority, to store the data coming from different experiments and which is available for plotting only during the dead times. The spectrum to be plotted is in the form of a series of points, the coordinates of which are in the computer memory. On account of the incremental character of the plotter, the apparatus computes and draws a line which does not deviate by more than half an increment from the straight line between two following points. In addition, the memory of the apparatus contains a description of alphanumeric characters allowing the writing down of a text and curve identification. (auth)

29745 (PH-30) PERFORMANCE OF NEUTRON DIFFRACTOMETER ON THE COMPARISON OF TWO MONOCHROMATORS CRYSTALS. Aladdin, B.; Ajaj, E.; Abul-Khail, A.; Zemlyanov, M. G. (Iraq Atomic Energy Commission, Baghdad. Nuclear Research Inst.). Nov 1974. 35p. Dep. NTIS (US Sales Only) $4.75.

The performance of a neutron diffractometer is influenced by a number of parameters that should be rigorously investigated. Among these parameters are the neutron flux distribution at the sample and the dependence of fwhm for Bragg reflections on monochromator angle and angular divergence of collimators. This investigation was directed at fixing the suitable parameters and the comparison of two single crystals, one made of pyrolytic graphite and the other made of lead to be used as monochromators. (auth)

29746 (RD/B/N-3163) CONVENIENT ELECTRICAL METHOD FOR THE EARLY DETECTION OF SODIUM LEAKS. Monaghan, V. A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

A simple method of monitoring for sodium leaks on rigs has been developed and proven. The system is readily combined with electrical trace-heating. It has been shown to be capable of detecting a leak of 2g in sodium in 20 seconds. It has been in use on a number of experimental facilities in these laboratories for several years and has been very reliable. (auth)

29747 (TID/SNA-1230) EVALUATION TESTING OF STATHAM PRESSURE TRANSDUCERS MODEL NO'S. PA751TC-1M-350 AND PA751TC-50-350. Supplement 1. Felter, M. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 Mar 1964. 19p. Dep. NTIS $4.00.

Evaluation test results and conclusions were derived from environmental testing of the following Statham candidate pressure transducers: one 0 to 1000 psia Model PA751TC-1M-350, S/N 5, and two 0-50 psia Model PA751TC-50-350, S/N 2 and 3. Environmental testing consisted of conducting pressure calibration cycles at specific points over a temperature range of 77 to 800°F. (auth)

29748 (UCRL-76460) AUTOMATIC CALIBRATION SYSTEM. Furst, R. C.; Sewall, N. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 12p. (CONF-741001-57). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

In the past three years, the High Speed Data Acquisition Group of the Nevada Automated Diagnostics System has acquired several hundred digital instruments of various types of gathering data on single transient waveforms. These instruments for the most part are high density CAMAC modules used typically for measuring peak amplitudes of high voltage pulses, making time interval measurements to subnanosecond accuracy, and performing high speed analog-to-digital conversion. Because of the high reliability and accuracy requirements of the Test Program, the checkout and calibrations required before fielding a module became very time consuming. To solve this problem a computer controlled calibration system was developed to automate as much of the testing as possible. (auth)

29749 INTERFERENCE FILTER FOR ULTRACOLD NEUTRONS. Antonov, A.V.; Isakov, A.I.; Mikerov, V.I.; Startsev, S.A. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 20: No. 9, 289-290 (5 Nov 1974).

We describe an interference filter for neutrons with energy ~ 10^{-3} - 10^{-4} eV. The filter consists of alternating layers of two different substances. The development and production of this filter can be of interest when it is necessary to filter out neutrons of required energy, and also to produce a neutron spectrometer with high resolving power in the indicated energy region. (auth)

29750 IMPROVEMENTS OF A MAGNETIC MONOPOLE DETECTOR. Eberhard, P.H.; Ross, R.R.; Taylor, J.D. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Rev. Sci. Instrum. 46: No. 4, 362-366 (Apr 1975).

Modifications to our previously described detector of magnetic monopoles resulting in substantial improvements in performance have been made. The sensitivity has been increased a factor of 35 by using a sensitive magnetometer (SQUID) to measure changes in current. The modifications, new measurement techniques, and implications for past and future experiments are described. (auth)

29751 THE USE OF A DESK CALCULATOR FOR THE ON-LINE MEASUREMENT OF ISOTOPIC ABUNDANCES. Mueller-Sohnius, D.; Cammann, K.; Koehler, H.; (Muenchen Univ. (F. R. Germany)). Int. J. Mass Spectrom. Ion Phys.; 15: No. 2, 155-164 (Oct 1974).

A simple and inexpensive on-line calculating system is described. The programmable Wang 600 desk calculator can be used for the evaluation of stable ionic currents of small mass ranges, when the measuring rate does not exceed 25 Hz. The application of this calculator for determining isotope ratios is demonstrated on measurements of the Eimer and Amend strontium standard. The Sr 87/86 ratio, normalized to Sr 88/86 = 8.375, was determined as 0.7081 using the peak-switching and scanning techniques. (auth)

29752 DATA HANDLING IN PHYSICS EXPERIMENTS. Amram, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique); Bianchi, G.; Corge, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Bull. Inform. Sci. Tech. (Paris); No. 194, 5-13(Jul 1974). (In French).

After reviewing the different stages of data handling in physics experiments, the list of the needs of the experimenters is established and the actual means are compared with the formulated requirements. The evolution of techniques is defined and outlook in the future is given. (FR)

29753 A METHOD FOR SIMULTANEOUSLY MEASURING THE DIMENSIONS OF A SAMPLE, AND A DILATOMETER FOR CARRYING OUT SAID METHOD. Warlop, R. (to CEA, 75 - Paris (France)). French Patent 2,185,095/F/. 16 May 1972. 11p. (In French).

The present addition is concerned with a method for simultaneously measuring at least two dimensions of a sample, and with a dilatometer, or expansion meter, for carrying out said method. That method comprises the steps of forming a hyper frequency carry resonator in the sample, of measuring resonance mode frequencies in equal number to the dimensions to be measured and of deducing the sample dimensions therefrom. The dilatometer comprises a cavity resonator, a sample the expansion of which is to be measured and means for measuring the resonance frequencies of said cavity. The invention can be applied, in particular, to the measurement of the expansion of materials. (FR)

29754 A METHOD AND DEVICE FOR MEASURING THE VELOCITY OF A LIQUID THROUGH A PIPE WALL. (to Canadian General Electric Co. Ltd., Peterborough, Ontario). French Patent 2,183,179/A/. 2 May 1973. 11p. (In French).

A procedure is described for determining the flow rate of a liquid in channelization by controlling the differences of conditions in the liquid causing momentary variation of the rate of propagation of ultrasonics, by observing these variations at two positions spaced axially with respect to the direction of flow of the liquid in the channel, and by establishing a delay time determinable by the signal received by the up-stream position in order to obtain the maximum degree of correlation between the control signals so that the flow time necessary for the passage of the propagation anomaly identified axially between the observation positions or posts will be the time delay value thus assuring an optimum correlation. Such a device is particularly convenient for the measurement of the velocity of a liquid in a channel traversed by a corrosive liquid or a costly liquid such as the heavy water of nuclear reactors. (tr-auth)

29755 A METHOD AND DEVICE FOR MEASURING THERMAL DIFFUSIVITY. Bonjour, E.; Doulat, J. (to CEA, 75-Paris (France)). French Patent 2,191,738/D/. 30 Jun 1972. 12p. (In French).

The device comprises two samples, viz a so-called reference sample associated to a control chain adapted to maintain its temperature at a desired level, and the sample to be examined, which is associated to two control chains, one of which is adapted to regulate the temperature of one side of the sample whereas the other maintains the screen at a given temperature, the sample other side being connected to a pulse generating source. The measurement consists in recording, on the sample first side, the power decrease resulting from a known pulse applied on the second side. The method can be used in the nuclear field. (FR)

29756 FAST PHOTOMULTIPLIER TUBES FOR NUCLEAR PHYSICS AND QUANTUM ELECTRONICS. Breuze, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 194, 15-23(Jul 1974). (In French).

Some concrete results, concerning in particular the standards of spectral sensitivity, gain and rapidity of recent photomultiplier tubes, are outlined. Most of the characteristic values given are experimental and representative of commercial tubes. (FR)

29757 CONTINUOUS MEASUREMENT OF THE LEVEL OF A CONDUCTIVE MEDIUM. Le Frere, J. P. (to Groupement pour les Activities Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). French Patent 2,186,641/A/. 30 May 1972. 8p. (In French).

The description relates to a device and a method for the continuous measurement of the level of a conductive medium, based on the variations of the mutual inductance of two windings mounted on a support member comprising ribs with automatic compensation for the shift due to temperature changes. This compensation is obtained by compounding the measurement carried out with a voltage which is a direct function of the resistance of one of said windings. This method can be applied to the measurement of the level of liquid sodium and aluminium. (auth)

29758 SENSITIVITY OF MEASUREMENT AND CONTROL INSTRUMENTS TO ELECTRICAL INTERFERENCES. Development of New Cables. Buisson, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 13-17 (Sep 1974). (In French).

On neutronic control system, pulsed measurement instruments are often those most liable to disturbance by electrical interferences. The mechanism of this effect is analyzed and it is shown that whatever the origin of electrical interferences, the same phenomenon is always observed: a flow of current on the shielding of the apparatus; perturbation of the measurements is caused only by the action of this current on the connectors, cables and shielding of the electronic equipment. The notion of transfer impedance characteristic of the immunity of cables of electrical interferences is defined and the results obtained with different cables, especially the new mu-metal shielded type developed under CEA licence, are given. (FR)

29759 DEVELOPMENT OF LARGE SIZE ELECTROMAGNETIC FLOW METER FOR SODIUM SERVICE. Nihei, T.; Mimoto, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Doryokuro Giho; No. 0, 86-95(Mar 1974). (In Japanese).

Electromagnetic flow meters (EMF) and differential pressure type flow meters are mainly used at present as the flow meter for sodium service. EMF seems to be suitable because of its excellent features, but has also some points to be clarified. Thus a 12 in. saddle-coiled EMF has been manufactured for trial and experimented. The EMF had a pair of air-core saddle-shaped coils mounted on a double wall duct, and DC magnetic field was generated. These were provided for measuring sodium flow. Five pairs of electrodes were positioned at the coil center and upstream and downstream. Four pairs of coils of different length were also manufactured to examine the field effect in the direction of flow. Measurements were carried out by putting a calibrated differential pressure type flow meter as standard and keeping the sodium temperature constant (ca. 370°C). Longer coils distinctly showed proper and better results. Interesting results were obtained for temperature effects on output deviation due to the position of the electrodes. Other results including the employment of a computer code for dry calibration were also obtained. (JA)

29760 STUDY OF NEUTRON GUIDE TUBE. Ishikawa, Y.; Kohgi, M.; Tajima, K.; Suzuki, M. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Watanabe, N. Kakuriken Kenkyu Hokoku; 6: No. 2, 281-283(Dec 1973). (In Japanese).

A preliminary experiment was performed for the practical use of neutron guide tubes. A small angle scattering apparatus for epithermal neutron scattering experiments was used as a measuring system. Samples used were glass plates on which nickel foils of about 2000 Å thickness were evaporated. The wavelength (λ) dependence of neutron reflectivity measured for the Ni foils was obtained and shown in figures. Since the values were close to one in the region of long wavelength, it was confirmed that total reflection had been realized in this region. A damping oscillation was seen on the shorter wavelength side rather than a rising wavelength. This damping oscillation can be expected theoretically, and depends on the resolving power of the apparatus and the state of reflective foils. (JA)

29761 PRECISE ANALYSIS OF CRYSTALLINE STRUCTURE BY TOF NEUTRON DIFFRACTION METHOD. Niimura, N. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science); Harada, J.; Takahashi, J. Kakuriken Kenkyu Hokoku; 6: No. 2, 268-275 (Dec 1973). (In Japanese).

A computer-controlled four axis goniometer was made to perform precise analysis of crystalline structure. Various factors contributing to the TOF neutron diffraction method were taken into consideration in designing the goniometer. The goniometer was installed at the Tohoku Linac ND Facility. Detection of neutrons was made by a ^3He counter which was shielded by B_4C. A method of background subtraction was investigated. Sources of background are tabulated, and the background was measured with a sample in off-Bragg mode near a principal axis. The same kind of measurement was made near another principal axis, and the background was estimated from the results. The measurement of the wavelength distribution $i(\lambda)$ of incident neutron intensity was performed. The distribution was obtained from the scattering data of vanadium with the correction for absorption, multiple scattering, and inelastic scattering. The direct observation of the direct beam was also carried out except for lower channels. By combining these data, the distribution $i(\lambda)$ was obtained and is shown. An automatic control system of the goniometer is under construction. (JA)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 29058.

29762 (CONF-750209-) URANIUM ENRICHMENT CONFERENCE, OAK RIDGE, TENNESSEE, FEBRUARY 13–14, 1975. (USERDA Oak Ridge Operations Office, Tenn.; Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 105p. Dep. NTIS $5.45.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (13 Feb 1975).

The conference was called to explain the Operating Plan for the ERDA Gaseous Diffusion Plants. An invitation to comment on the proposed plan was contained in a Federal Register Notice (40FR1117) dated Jan. 6, 1975. The information at the meeting was to provide detailed background to assist those persons wishing to respond to the Federal Register Notice. At the meeting ERDA indicated its intent to distribute the papers in early March. During the course of the conference, questions pertaining to the Operating Plan and to the Federal Register Notice were raised and answered. Some of the answers have been incorporated in revisions to the original presentation. In addition, during the conference numerous written and oral questions were raised and some answers provided on the Jan. 15, 1975 offer to modify delivery schedules for enrichment service customers affected by reactor slippages. Some general questions on uranium enrichment service contracting were also raised and answered. To expedite distribution of data on the Operating Plan, all of these questions, together with complete answers, will be issued as a separate document. The papers presented included: Introduction; Union Carbide Nuclear Division Operations; Operating Features of the Gaseous Diffusion Process Complex; Operational Planning; Operating Plan for the ERDA Gaseous Diffusion Plants; Working Inventory of Enriched Uranium; Possible Deviations in the Operating Plan; Spent Fuel Reprocessing; Variable Tails Assay Option; and Uranium Supply Situation. (TFD)

29763 (DPSPU-74-30-9) EVALUATION OF TRAY PERFORMANCE USING GAMMA SCANNING. Jones, D. W.; Jones, J. B. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant; Du Pont de Nemours (E. I.) and Co., Wilmington, Del. (USA). Engineering Dept.). Jan 1974. Contract AT(07-2)-1. 17p. (CONF-750329-1). Dep. NTIS $4.00.

From American Institute of Chemical Engineers meeting; Houston, Texas, USA (16 Mar 1975).

The hydraulic performance of three sieve-tray designs and a bubble-cap tray design was evaluated in 11-ft-dia, GS heavy water process cold towers (H_2S-water system at 33°C, 300 psia). Tray flooding characteristics, weep points, and pressure drops were determined. Techniques of gamma radiation scanning and air-water tray simulation used in the evaluation, provided valuable information. Sieve tray pressure drops were similar and about 30% less than bubble-cap tray pressure drop near the bubble-cap flood point of 1.75 F-factor (based on tray bubbling area). Unfortunately, gas blower capacity limited F-factor to about 1.8, and sieve tray flood points under normal operating conditions could not be determined. Heavy weeping occurred below 1.0 F-factor with all three sieve designs. Two of the sieve designs provided exceptional resistance to flooding because of foaming associated with abnormally high feedwater turbidity. Either of these two tray designs and a cold tower F-factor of 1.8 are suggested for future GS heavy water plants. (auth)

29764 (K-L-6344) PROCESS SELECTION FOR NEW URANIUM ENRICHMENT PLANTS. Wilcox, W. J. Jr.; Lang, D. M.; Levin, S. A. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). [nd]. Contract W-7405-eng-26. 22p. (CONF-750324-2). Dep. NTIS $4.25.

From international conference on uranium isotope separation; London, UK (5 Mar 1975).

Over the years the group at Oak Ridge has given consideration to many uranium isotope separation processes. From the United States viewpoint, the leading established candidates for process selection for new plants are the gaseous diffusion and the gas centrifuge processes. The principal factors used in evaluating all processes are discussed and examples are given of the kind of evaluations made of ideas, proposals, or processes when relatively little information is available. The results of more detailed evaluations and comparisons of the diffusion and centrifuge processes are presented together with comparative costs and non-economic factors. (auth)

29765 (KY-L-749) OPERATING EXPERIENCE WITH U. S. GASEOUS DIFFUSION PLANTS. Hopkins, C. C. (Paducah Gaseous Diffusion Plant, Ky. (USA)). [nd]. Contract W-7405-eng-26. 13p. (CONF-750324-1). Dep. NTIS $4.00.

From international conference on uranium isotope separation; London, UK (5 Mar 1975).

The only large-scale production facilities in operation throughout the world today for uranium enrichment are gaseous diffusion plants. The three U. S. plants have operated with great reliability for more than twenty years. The well-planned operating and maintenance programs of the past with the modernization programs now underway will assure continued effective and efficient operation in the future. (auth)

29766 (LIB/Trans-553) ECONOMIC COMPARISON OF URANIUM ENRICHMENT PROCESSES. Brown, R.; Geipel, H.; Iwand, J. Translated by A. Bicevskis from Atomwirt., Atomtech.; [19]: 536-539(1974). 21p. Dep. NTIS (US Sales Only) $4.25.

An economic comparison of the various enrichment processes is problematic mainly because the capital costs are subject to large uncertainties as a result of different conditions used in the ground rules. The price of the electricity in the region considered also has a large bearing on the competitive position. Centrifuge, diffusion and nozzle separation processes are compared for plants reaching full production in 1982. The economic effect is investigated in the important parameters such as electricity cost, capital cost, sales revenue and the rate of price increases. (auth)

29767 (UCRL-76306) EXCITED STATE SPECTROSCOPY OF ATOMIC URANIUM. Solarz, R.; Carlson, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. 24p. (CONF-750333-1). Dep. NTIS $4.25.

From Optical Society of America spring conference; Anaheim, California, USA (19 Mar 1975).

A review of the spectroscopic knowledge of uranium as it applies to laser isotope separation is presented. (TFD)

29768 INSTALLATION FOR SEPARATING A GASMIXTURE OF GASEOUS ISOTOPES. (to NV Koninklijke Maatschappij 'De Schelde'). Netherlands Patent 7,207,837. 9 Jun 1972. 4p. (In Dutch).

The invention provides a removable but gastight joint for connecting the pipelines to and from a number of ultracentrifuges in cascade to their respective mains. (auth)

29769 ISOTOPE SEPARATION IN LASER–STIMULATED CHEMICAL REACTIONS. Basov, N.G.; Belenov, É.M.; Gavrilina, L.K.; Isakov, V.A.; Markin, E.P.; Oraevskiĭ, A.N.; Romanenko, V.I.; Ferapontov, N.B. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 20: No. 9, 277-278 (5 Nov 1974).

Isotopes of nitrogen were separated in the laser–stimulated reaction $N_2+O_2 \rightarrow 2NO$. An isotope separation coefficient $\beta \sim 100$ was reached for ^{15}N and ^{14}N. The reaction was stimulated in a cell with air, with simultaneous action of ruby–laser radiation and of the intense Stokes component obtained beforehand by SRS in liquid nitrogen. (auth)

29770 PROCESS FOR OBTAINING DEUTERIUM. Trichet, J.; Simonet, G.; Guellaff, J. P. (to L'Air Liquide, Societe Anonyme pour l'Etude et l'Exploitation des procedes Georges Claude). US Patent 3,864,466. 4 Feb 1975. Priority date 27 Jan 1970, France. 6p.

The present invention relates to a process for obtaining deuterium from hydrogen, in which at least a part of the hydrogen is formed from recycling hydrogen, obtained from the gaseous stream originating from the said oxidation, purified beforehand from quantities of water which it contains by cooling and condensation. (Official Gazette)

29771 FUTURE STRUCTURE OF THE URANIUM ENRICHMENT INDUSTRY. Part 3, Volume I. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session on Continuing Assessment of Actions Underway, Contemplated, or Suggested, to Insure Supply of Enriched Uranium Sufficient to Meet Present and Future Needs, June 25, 26, and 27; July 16, 17, 18, 30, 31; August 6; November 26; and December 3, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 798p. GPO $6.30.

Hearings held during June, July, August, November, and Dec. 1974 before the U. S. Senate Joint Committee on Atomic Energy on plans to insure an adequate supply of enriched uranium for future needs are presented verbatim. Supplementary correspondence on uranium enrichment is included. (LCL)

29772 SLOT NOZZLE FOR THE SEPARATION OF GASEOUS ISOTOPE MIXTURES. Wodrich, G. W.; Heckh, G.; Zerweckh, M. (to Siemens A. G., Berlin (F. R. Germany); Siemens A. G., Muenchen (F. R. Germany)). German(FRG) Patent 2,009,265/C/. 30 May 1973. 5p. (In German).

The patent claims refer to a slot nozzle for the separation of gaseous isotope mixtures with a gas-inlet channel, a buckled Lavall-nozzle consisting of a baffle and a deflection wall, a skimmer plate as well as delivery channels for the light and for the heavy fraction. (auth)

29773 A DEVICE FOR SEPARATING THE COMPONENTS OF A GAS MIXTURE. Blouvac, R. (to CEA, 75 - Paris (France)). French Patent 2,180,542/A/. 20 Apr 1972. 8p. (In French).

This device is constituted by stocked groups of elementary separation cells, each of said groups comprising a number of stages arranged in series, each of said stages comprising a plurality of cells arranged in parallel and operated by a common stage collector, the mutual assembly of the various groups being achieved by means of four ducts connected with the terminal stage collectors, while all the stage collectors of each group are fed, as a whole, by a single conduit. This device can be applied to the separation of uranium isotopes. (FR)

29774 DAMPED PIVOT FOR HIGH-SPEED ROTATING MACHINES. Bourassin, R. (Societe Bertin et Compagnie, 78 - Plaisir (France)). (to CEA, 75 - Paris (France)). French Patent 2,192,642/A/. 13 Jul 1972. 9p. (In French).

This pivot comprises a bearing submitted to a resilient centering return member; a pressurized-fluid film in the gap between a bore of the bearing and a guide-portion of the pivot; a pedestal with a damping chamber for housing the bearing and an adjacent feed chamber, these chambers communicating with each other; pressurized-fluid ducts provided in the bearing for communicating the above gap with the feed chamber. The invention can be applied to ultracentrifuges for isotope separation (FR)

29775 PROCESS FOR PREPARING HEAVY WATER FROM SEA WATER. Tabata, H.; Tabata, N.; Nakajima, R. US Patent 3,870,606. 11 Mar 1975. Priority Date 26 Jun 1969, Japan. 12p.

A process is described for preparing heavy water from the sea water, comprising collecting drains, i.e., condensate; produced in the manufacture of common kitchen salt from sea water treatment and in the treatments of byproducts from the manufacturing process, adding to the mixture of drains a small amount of inorganic salts, warming the mixture of drains above room temperature and below 40°C by the exhaust heat evolved in the evaporation stage of the salt manufacturing process, in a cool concentration apparatus, and then further concentrating the mixture thus obtained in a thermal evaporation step. (Official Gazette)

Isotopic Power Sources

Refer also to abstracts 29334–29336 and 29534.

29776 (DPST-75-128-2) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Feb 1975. Contract AT(07-2)-1. 32p. Dep. NTIS $4.75.

In PuO_2 characterization studies, the following items were observed: variation in nitric acid concentration of the Pu feed to the oxalate precipitation step had a slight effect on morphology and particle size of calcined $^{239}PuO_2$ but did not affect surface area; particle size analyses indicated two formative processes occur in precipitation of ^{238}Pu oxalate particles; and mean particle size of SRP $^{238}PuO_2$ on a population distribution basis is less than 0.8 μm compared to 2 to 10 μm determined on the basis of mass. Impurity analyses of pure plutonium oxide (PPO) pellets fabricated from SRP feed showed: cationic impurities are within Multihundred Watt (MHW) specifications for Mound Laboratory production, with the possible exception of silicon; calcium, copper, sodium, and nickel concentrations are reduced during pellet fabrication, and aluminum, iron, chromium, and silicon are increased; and carbon levels of 50 to 200 ppM in hot-pressed pellets are generally reduced to less than 50 ppM after final heat treatment. (auth)

29777 (LA-5820) HELIUM RELEASE OF ^{238}PLUTONIA–MOLYBDENUM CERMET FUEL. Mueller, B. A.; Rohr, D. D.; Land, C. C.; Mulford, R. N. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1974. Contract W-7405-ENG-36. 18p. Dep. NTIS $4.00.

The experiments described are part of a continuing effort to characterize the helium release behavior of radioisotopic heat source fuels. Helium is a product of the alpha-decay of the ^{238}Pu isotope. Helium release rates and microstructural changes during long-term isothermal anneal experiments were determined for plutonia–molybdenum cermets. The helium release data were fitted in part with a classical diffusion model. The time the cermet was held at temperature seemed to determine the amount of bubble formation in the grain boundaries, the amount of swelling, and the fracture mode of the cermet. (auth)

29778 (ORNL-TM-4865) PRODUCTION OF IR–0.3% W DISKS AND FOIL. Braski, D. N.; Schaffhauser, A. C. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 28p. Dep. NTIS $4.50.

The production of Ir–0.3% W disks (2⅜ in. diam × 0.025 in. thick, 60 × 0.64 mm) for fuel cladding used in the Multi-Hundred Watt (MHW) isotopic heat source is described. Cleaning of disk surfaces was improved by electrolytic etching in KCN. Rolling temperatures were raised 100°C because production batches of iridium alloy exhibited 100°C higher recrystallization temperatures than earlier material. Improved surface finishes were obtained by using a fine grit alumina grinding wheel. A total of 484 disks were fabricated, of which 415 met specifications. Also, 687 in.^{2} (0.443 m^2) of 0.005-in.-thick Ir–0.3% foil was also manufactured for the MHW heat source. (auth)

29779 PROCEDURE FOR THE SAFE SOLIDIFICATION OF RADIOACTIVE MATERIALS IN A CONTAINER. (to SKF Industrial Trading and Development Co.). Netherlands Patent 7,300,552. 15 Jan 1973. 6p. (In Dutch).

A container, partly filled with radioactive powder or granular mass, is transferred to a hot cell. It is shaken until the density is 50 to 60%. The container is evacuated and closed by electron-beam welding, and then transferred to a second container filled with liquid metal, e.g., lead. Both containers are compressible. The container combination is compacted in a hydraulic press by a hot-compacting process at a pressure of at least 1000 bar and a temperature of more than 1200°C. The final product is a bar-shaped isotopic heat source which is easy to handle. (NL)

Radiation Sources

Refer also to abstracts 29576 and 29888.

Design and Fabrication

29780 NEUTRON TUBE FOR RADIATION THERAPY. Reifenschweiller, O. (Philips Gloeilampenfabrieken NV, Eindhoven, Netherlands); Colditz, J.; van Houwelingen, D. Medicamundi; 19: No. 1, 20-21(1974).

An ion accelerator designed as a sealed-off tube in which the nuclear reaction between tritium and deuterium generates monoenergetic neutrons of 14 MeV with an output of approximately 10^{12} n/sec is described. The tube can be mounted in an irradiation head, permitting isocentric moving beam treatment. (NL)

29781 DEVICE FOR THE PERFORMANCE OF RADIATION CHEMICAL AND MICROBIOLOGICAL EXPERIMENTS. Kaushansky, D. A.; Kollanow, D. M.; Bibergal, A. W.; Emelianow, K. N.; Eletsky, D. J.; Frolow, E. W.; Lutsek, W. P. (to AN SSSR, Moscow. Inst. Organicheskoj Khimii). German (FRG) Patent 1,598,613/S/. 17 May 1973. 5p. (In German).

The invention concerns an irradiation device, the essential feature being a detachable lead container with a sleeve, containing a hollow cylindrical emitter. A working chamber is arranged which is supported by a lifting device which can be walled-off by means of locks which are formed by a liftable sample-container girder. (GE)

Industrial Uses

Refer also to abstracts 29076, 29167, 29530, 29827–29834, 29955, and 29981.

29782 (APIA-T-09-01-002) WHOLESOMENESS OF IRRADIATED POTATOES IN MICE. No. 2. Bernardes, B.; da Silva, S. M.; da Silva Moraes, S. (Administracao do Programa de Irradiacao de Alimentos, Rio de Janeiro (Brazil)). 1973. 61p. (In Portuguese). INIS.

To study the wholesomeness of irradiated potatoes, 120 mice were divided into 4 groups. The first group received normal rations; the second was fed with rations containing 35% of non-irradiated potatoes; the third received rations containing 35% of potatoes irradiated with 8 Krad; finally the last group received rations containing 35% of potatoes irradiated with 16 Krad (cobalt-60). The biological interpretation deduced from this study did not reveal in the test animals any abnormality which could be

attributed to the irradiated food. Twenty mice, which died naturally or were sacrificed, were examined under a histopathological point of view. Physiochemical analyses of the irradiated or unirradiated potatoes had as an objective the determination of nutritive value, having in view the balancing of the rations distributed to the mice. The results encountered in all the cases were satisfactory. Statistical evaluations were consistent with the biological analyses. The statistical analysis of the gestation period showed a small discrepancy, acceptable in light of the sample number of animals used, whose variations cannot be said to be due to the differences in radiation doses. (INIS)

29783 (CEA-CONF-2838) PROSPECTS OF USING CESIUM FOR RADIOSTERILIZATION. Eymery, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Chimie Appliquee). Mar 1974. 26p. (CONF-741217-2). Dep. NTIS (US Sales Only) $4.50.

From symposium on ionizing radiation for sterilization of medical products and biological tissues; Bombay, India (9 Dec 1974).

The development of nuclear energy leads to the production in power reactors of large quantities of useful radioisotopes, e.g., ^{137}Cs. Safety considerations have led to the construction of fission product separation facilities. Thus, during 1974 ^{137}Cs separated at Hanford will become available. No decisive technical argument can direct the choice between ^{137}Cs and its main competitor ^{60}Co. Although the present prices appear to be more or less artificial, the choice of ^{137}Cs could be economically justified, but the difference of cost compared with ^{60}Co is very small. A decrease of the price announced for ^{137}Cs could lead to a significative development of its market. (auth)

29784 ON-LINE WEAR MONITORING BY SURFACE ACTIVATION. Askouri, N. A.; Chen, N. S.; Ettinger, K. V.; Fremlin, J. H.; Nowotny, R.; Willis, G. B. (Univ. of Birmingham, Eng.). Int. J. Appl. Radiat. Isotop.; 26: No. 2, 61-70(Feb 1975).

Charged particle activation offers a method for studying wear in machine tools. It has been used to study experimentally the wear in tungsten carbide dies. Two dies were activated, to a depth of about 70 μm in the bearing region by bombardment with a beam of 30 MeV ^{3}He ions. The dies were run in a laboratory wire drawing machine and the decrease in die activity was used to estimate the diametral increase in die bore. The results were compared with micrometer measurements of the diameter of the drawn wire and showed an encouraging measure of agreement. The technique can provide a radiometric method for measuring wear in machine tools which could be used on-line in the industrial environment. The paper also describes the facilities used for the irradiation and for monitoring the induced radioactivity. (auth)

29785 STUDY OF THE HONEY STORAGE BY BEES BY MEANS OF A SUGAR SYRUP TRACED WITH ^{141}Ce. Douault, P.; Louveaux, J.; Theurkauff, J. (Institut National de Recherches Agronomiques (INRA), 91 - Bures-sur-Yvette (France). Station de Recherches sur l'Abeille et les Insectes Sociaux); Azoeuf, P.; Pintena, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. des Radioelements). Apidologie; 5: No. 2, 107-126(1974). (In French).

^{141}Ce was used to trace a syrup in the proportion of 500 μCi/l, which was supplied as feeding to seven honeybee colonies at the rate of one l'ter per week between the 23rd of March and the 13th of April 1973. Dadant hives were used and supers were added on the 19th of April at the beginning of an important rape nectar flow. Residual radioactivity in these supers was measured at the end of the nectar flow on the 29th of May. In each frame of all experimental hives, the presence of ^{141}Ce in honey stores was obvious. Nevertheless, the radioactivity rate was not the same in every frame, for some were more active than others. At the end of the experiment the radioactivity found in supers varied between 2.4 and 6.3% of the theoretical residual radioactivity. It corresponded to the moving by bees of 2 to 8.4 g of saccharose into every kg of gathered honey. The theoretical and practical meaning of bees moving feeding sugar into supers is discussed, with special regard to the risk of honey pollution by medicinal stuffs. (FR)

29786 INDUSTRIAL APPLICATIONS OF RADIOACTIVE TRACERS. Settipani, A. (Societe Qualitest, 92 - Levallois-Perret (France)). pp 111-119 of 3. Colloquium on Nondestructive Testing Methods, 14-16 May 1974. Issy-les-Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French).

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

The advantages and criteria of the use of radioactive tracers in industry are presented and the most common fields of application are described: measurement of flowrates; residence times; air turnover rates; and leak detection on buried pipes. (FR)

29787 INFORMATION RELATING TO THE WHOLESOMENESS OF IRRADIATED FOOD. Food Irradiat. Inform.; No 3, Suppl., 16-46(Jun 1974).

A survey is given of the present status of the information relating to the wholesomeness of irradiated food. The data and results have been assembled by the staff of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture. The results of the different countries for the different foodstuffs are represented separately. (GE)

29788 AMOUNT OF RESIDUAL DETERGENTS REMAINING ON THE SURFACE OF WASHED PIECES OF CROCKERY. Schmitz, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Lab. fuer Isotopentechnik). 10: No. 1, 11-13(1973). (In German).

The amounts of detergent remaining on the surface of washed pieces of crockery were quantitatively determined, using the tracer technique in conjunction with radioactively marked compounds. The amount of residual detergent was shown in these tests to depend not so much on the nature of the substrate (i.e., glass, porcelain, polystyrene, polycarbonate) and its surface roughness, but rather on the detergent concentration of the wash liquor. (auth)

29789 APPLICATION OF PHYSICAL STERILIZATION PROCEDURES FOR THE PRODUCTION OF ASEPTIC PACKAGES AND CONTAINERS. Sturm, W.; Gilliand, A. (Aluminiumwerke A. G., Rorschach (Switzerland)). 25: No. 4, 298-302(1974). (In German).

The availability and application of electron beam treatment and ultra-violet radiation in sterilisation of packaging material and containers are described. Bacteriological results of radiation trials are given together with results of bacteriological contamination tests on lacquered aluminum foil and strip. (auth)

29790 A METHOD FOR IMPROVING CELLULOSE FIBERS. Gaussens, G. (CEA, 75 - Paris (France)); Schutz, R. (Ecole Superieure de Chimie, 68 - Mulhouse (France)). (to CEA, 75 - Paris (France)). French Patent 2,189,565/A/. 16 Jun 1972. 13p. (In French).

The method consists in grafting a polyampholyte onto cellulose fibers after irradiation. Cotton fabrics treated according to the invention show no tendency to crumpling when dry, are easily uncrumpled when wet and have good affinity for dyes. They can easily be given a permanent pleat. (FR)

29791 THE STUDY OF THE RELATIONSHIPS BETWEEN PARAFFINATION, PARAFFIN CONTENT AND COEFFICIENT OF FRICTION BY MEANS OF THE TRACER TECHNIQUE. Luenenschloss, J. (Technische Hochschule Aachen (F. R. Germany). Inst. fuer Textiltechnik); Schuler, B. G. (Institut fuer Textiltechnik, Reutlingen (F. R. Germany)); Vogg, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Lab. fuer Isotopentechnik). Text.-Prax.; No. 2, 76-79(1973). (In German).

4 figs.; 2 tabs.; 6 refs.

The relationships between the fiber tension when spooling and paraffining, the paraffin content and the course of the coefficient of friction for three different strengths of pariffination are dealt with by neutron activation analysis of cobalt phthalocyanine in the paraffin. (auth)

29792 USE OF RADIOTRACER METHODS IN ELECTROPLATING. I. Gold. Stverak, B. (Ustav pro Vyzkum, Vyrobu, a Vyuziti Radioizotopu, Prague); Srb, M.; Vrobel, L. Radioisotopy; 15: No. 4, 465-585(1974). (In Czech).

This paper devoted to radiotracer applications in electroplating is concerned with the problems of electrogolding baths. The physico-chemical properties of golding baths, the types of baths and the properties of gold coatings are given. The radiotracer methods for the testing of throwing power, for the study of alloy deposition and incorporation of admixtures in the gold coatings are described. (auth)

29793 GAS CHROMATOGRAPHIC STUDIES ON THE SUITABILITY OF IRRADIATED POTATOES FOR STORAGE AND PROCESSING. Rumpf, G. (Institut fuer Strahlentechnologie der Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Potato Res.; 16: No. 1973, 296-301(1973).

In two series of experiments, batches of potatoes, some treated by irradiation and some with chemical sprout inhibitors, were processed into chips on an industrial scale after 7 to 8 months of storage. The quality of the chips and of the stored fresh potatoes was related to gas chromatographic analyses of sugar and acid contents. It was found that only the irradiated potatoes in which the content of fructose and glucose at the time of processing amounted to not more than 0.07% each of the fresh weight, yielded marketable chips of good quality. If the concentrations of reducing sugars were as low as this, then the rate of rotting was also very low, even in the irradiated batches. Shipment of the potatoes

by truck over a distance of approximately 300 km after irradiation had no detectable deleterious effect. (auth)

29794 RADIOTRACER METHOD FOR THE DETECTION OF LATENT FINGERPRINTS. Stverak, B. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague); Kopejtko, J.; Chodora, F.; Chyska, J. Radioisotopy; 15: No. 6, 805-817(1974). (In Czech).

To extend the potentialities of visualization of latent fingerprints, a radiotracer method using the radioisotope ^{110m}Ag as tracer and autoradiography as detection technique was developed. The method was tested on glass, paper, and some plastics. On paper, the latent dactyloscopic marks may be visualized after previous developing with ninhydrin. The method enables development of satisfactory dactyloscopic images on polyethylene and artificial leather where the classical methods fail. (auth)

29795 IMPROVEMENTS IN OR RELATING TO IRRADIATORS. Reid, E. W.; James, B. C. (to Nuclear Engineering Ltd.). British Patent 1,372,637/B/. 6 Nov 1974. Filed Date 10 Apr 1972. 9p.

An irradiating assembly is described comprising a radiation impermeable housing containing an irradiation chamber, with a radiation impermeable door, and a second chamber adjacent to the irradiation chamber and communicating with it. A radiation impermeable shutter is located within the second chamber, having on one surface means to receive high energy radioactive sources, and being movable between a position in which the sources are exposed to the irradiation chamber and a position in which the irradiation chamber is shielded by the shutter. A cavity is provided in the shutter to receive the sources. The second chamber and the shutter are preferably cylindrical. The shutter cannot be moved to the first position when the door to the irradiation chamber is open, and it is preferable that the door cannot be opened when the shutter is in the first position. (UK)

29796 JAIF ISSUES REPORT ON USES OF RADIOISOTOPES AND RADIATION. Indicating Current Trend in Japan. At. Jap.; 18: No. 6, 22-40(Jun 1974).

As radioisotope and radiation are finding wider applications in Japan, all those working with radioisotopes need to more earnestly strive to ensure safe management of these modern tools. The actual uses of radiation in Japan was shown in the following tables and charts to give an idea of the present trend. I. Distribution of radioisotopes: Domestic distribution mechanism of radioisotopes and main radioisotope imports in value and volume were outlined. II. Users of radioisotopes: It outlined that annual change in the number of radiation-users, service-level breakdown of users, annual change in number of facilities and gauges used in private industry and industry-level list of radiography facilities and isotope gauges used in private industry. III. Commercial application of radioisotopes and radiation: It outlined that commercialized chemical reactions of radiation, electron accelerators installed for industrial purposes and intensive irradiation facilities. IV. Expenditures and sale related to radioisotopes and radiation in mining and manufacturing industries: It outlined that expenditures at operational and industrial levels, expenditures on R & D, R & D investiment factors and sales classified by capital. V. Personnel in radioisotope and radiation field: Number of people engaged in RI or radiation work and number of researchers and engineers in service and academic training level were outlined. VI. Major accident statistics involving radioisotopes: Accidents involving sealed radioisotopes and non-sealed radioisotopes were outlined. (JA)

LIFE SCIENCES

Refer also to abstracts 32365, 32401, and 32402.

Radiation Effects on Biochemicals

Refer also to abstracts 29017, 29812, 29819, 29837, and 32398.

29797 (COO-2468-1) POTENTIAL RADIOSENSITIZING ANTIVIRAL AND ANTICANCER PYRIMIDINE NUCLEOSIDES. Technical Progress Report, June 1, 1974–February 1, 1975. Prusoff, W. H. (Yale Univ., New Haven, Conn. (USA). School of Medicine). 1975. Contract AT(11-1)-2468. 8p. Dep. NTIS $4.00.

Several compounds proposed for synthesis in the contract were prepared. These include: 5′-amino-2′,5′-dideoxy-5-iodouridine, 5′-azido-2′,5′-dideoxy-5-iodouridine, 5′-azido-2′,5′-dideoxy-5-bromouridine, 5′-azido-2′,5′-dideoxy-5-chlorouridine and the multisubstrate analog of ATP and thymidine (N-(5′-adenosyl), N′(5′-thymidyl)-azelaamide). In addition the synthesis of 5-iodo-6-aza-2′-deoxyuridine was accomplished. The radiation sensitization by these compounds of purified thymidine kinase derived from E. coli and Sarcoma-180 cells has been evaluated. Kinetic analysis has been performed to determine which compound is a substrate and the type of interaction with the enzyme. For this end the K_I was determined for each of these compounds. The effect of those compounds on the sensitivity of these enzymes to inactivation by ultraviolet radiation has been investigated. The order of radiation sensitization by the 5′-azido-nucleoside derivatives of the mammalian thymidine kinase is 5′-N_3-IdUrd > 5′-N_3-BrdUrd > 5′-N_3CldUrd. 5′-amino-2′,5′-dideoxy-5-iodouridine is slightly less potent than 5′N_3 IdUrd as a radiation sensitizer of mammalian thymidine kinase. Of particular importance is the finding that 5-iodo-6-aza-2′-deoxyuridine is not a substrate for either the bacterial or the mammalian thymidine kinase and yet is the most potent sensitizer. It is even more potent than 5-iodo-2′-deoxyuridine (IdUrd). Since 5-iodo-6-aza-2′-deoxyuridine is not a substrate, it presumably cannot be incorporated into DNA and hence will probably be a relatively non-toxic substance. (auth)

29798 NATURE OF THE DOSE RATE EFFECT IN THE γ IRRADIATION OF PROTEINS. Kharchenko, L. I.; Pavlovskaya, T. E.; Nesterov, V. A. (Inst. of Biochemistry, Moscow). Dokl. Akad. Nauk SSSR; 217: No. 2, 481-484(1974). (In Russian).

The purpose of the study was to show the role of oxygen in the production of the dose rate effect during irradiation of proteins, based on the direct determination of the coupling of the oxygen with the protein in the irradiation process as a function of the radiation intensity. The 10% aqueous solutions and dry samples were irradiated by ^{60}Co γ rays to a dose of 1000 kR at dose rates of 50, 100, 200, and 400 R/sec in an atmosphere of oxygen enriched 41% with ^{18}O. The data showed that during γ irradiation the amount of oxygen participating in the radiation-chemical reactions depends on the dose rate. The amount of oxygen participating increased with decrease of the dose rate. (JSR)

29799 INHIBITION AND AMPLIFICATION OF THE RADIATION-INDUCED DEGRADATION OF DNA IN ESCHERICHIA COLI. Myers, D. K. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Microbiol.; 21: No. 1, 27-33(Jan 1975).

The degradation of DNA in a repair-proficient strain (B/r) and in two repair-defective strains (B_{s-1} and pol A) of Escherichia coli was studied in the presence and absence of three metabolic inhibitors after exposure of the cells to x radiation. The radiation-induced degradation of DNA was dependent on energy production in freshly harvested log-phase cells and was closely related to the repair capacity of the cells. A different system, probably involving nonspecific deoxyribonucleases acting at radiation-induced strand breaks, appeared to be responsible for the degradative processes in stationary-phase cells or in log-phase cells which had been aged by standing in buffered saline for 2 days before irradiation. The three inhibitors tested (caffeine, rifampin, and carbonyl cyanide m-chlorophenyl hydrazone) were all found to inhibit partially the radiation-induced degradation of DNA in E. coli cells. Under other conditions, the same three compounds amplified the degradative process. The data suggested that the amplification was due to a selective inhibition of repair processes. The degradative processes which were stimulated by x radiation of E. coli cells show many parallels to those which are evoked by phleomycin or colicine. (auth)

29800 SELECTIVE ACTIVATION OF DNA REPARATIVE SYNTHESIS BY INDOLYLALKYLAMINES AND ITS ROLE IN THE RADIOPROTECTING EFFECT OF THESE COMPOUNDS IN ESCHERICHIA COLI. Bresler, S. E.; Noskin, L. A.; Sverdlov, A. G.; Stepanova, I. M. (Inst. of Nuclear Physics, Leningrad). Dokl. Akad. Nauk SSSR; 219: No. 4, 985-987(1 Dec 1974). (In Russian).

The effects of mexamine (5-methoxytryptamine) on the different reparative systems of E. coli exposed to γ radiation at a dose rate of 12 krad/min were studied using wild K12 and its thymine-deficient mutants. The results show that the radioprotective effects of mexamine are to a significant degree connected with the activation of post-radiation DNA reparation. The extent of the radioprotective effect depends on the character of the mutating injury to the systems for DNA reparation. It was concluded that mexamine selectively activates ligase and recombination systems of repair and has little effect on the polymerase system. (JSR)

29801 ENDONUCLEASE FROM DICTYOSTELIUM DISCOIDEUM THAT ATTACKS ULTRAVIOLET-IRRADIATED DEOXYRIBONUCLEIC ACID. Deering, R. A.; Jensen, D. S. (Pennsylvania State Univ., University Park). J. Bacteriol.; 121: No. 3, 1211-1213(Mar 1975).

An endonuclease activity yielding single-strand breaks in ultraviolet light-irradiated φX-174 RF I DNA in vitro has been detected in homogenates of the amoebae of the cellular slime mold, Dictyostelium discoideum. (auth)

29802 ESR KINETICS OF A FREE RADICAL CONVERSION IN γ-IRRADIATED ORIENTED DNA. Graeslund, A.; Ehrenberg, A.; Rupprecht, A.; Tjaellidin, B.; Stroem, G. (Stockholm Univ.). Radiat. Res.; 61: No. 3, 488-503(Mar 1975).

In oriented DNA, ESR studies were performed on the decay of the primary anionic base free radicals, γ-induced at 77 K, and the formation of the secondary hydrogen addition free radicals on the thymine base at different elevated temperatures. Quantitatively and kinetically there is a close correspondence between these two processes, thus confirming the reaction pattern $\dot{T}^- + XH^+ \rightarrow \dot{T}H + X$, where $\dot{T}^-$ is the anionic and $\dot{T}H$ the hydrogen addition free radical on thymine, and X indicates that the source of hydrogen ions is not known. The kinetics of the free radical conversion can be described by a model in terms of a fractional first (or pseudo-first)-order reaction between spatially correlated pairs of $\dot{T}^-$ and XH^+ with a distribution of activation energies. (auth)

29803 γ-IRRADIATION OF AQUEOUS SOLUTIONS OF HORSERADISH PEROXIDASE IN DIFFERENT ATMOSPHERES: ARGON, AIR, AND NITROUS OXIDE. Delincee, H.; Radola, B. J. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (F. R. Germany). Inst. fuer Strahlentechnologie). Radiat. Environ. Biophys.; 11: No. 3, 213-218(Oct 1974).

Horseradish peroxidase has been γ-irradiated in dilute aqueous solution under argon, air, and nitrous oxide. The results indicate that the OH radicals are of primary importance for the radiation inactivation of peroxidase. By thin-layer isoelectric focussing a shift in the distribution of enzyme activity towards lower isoelectric points was detected in the order argon < air < N_2O. Thin-layer gel chromatography revealed enzymatically active aggregates, the formation of which could be attributed mainly to the OH radicals. (auth)

29804 ENDONUCLEASE II OF ESCHERICHIA COLI: DEGRADATION OF γ-IRRADIATED DNA. Kirtikar, D. M.; Slaughter, J.; Goldthwait, D. A. (Case Western Reserve Univ., Cleveland). Biochemistry; 14: No. 6, 1235-1244(25 Mar 1975).

Irradiation of DNA in a nitrogen atmosphere with ^{60}Co γ-radiation produces at least two types of damage. The first type leads to single strand breaks in the DNA observed after exposure to alkali. This type of alkali-labile bond will be designated a spontaneous break. The second type of damage to DNA is an alteration which makes the DNA susceptible to phosphodiester bond hydrolysis by a 1600-fold purified preparation of endonuclease II of Escherichia coli and is designated an enzyme-sensitive site. This site is not alkali-labile. After irradiation, preincubation of the DNA either for days at 0° or for 4 hr at 37° increases both the spontaneous breaks and the enzyme sensitive sites. There is a greater increase of spontaneous breaks when the preincubation is in O_2 compared to N_2. The increase of enzyme sensitive sites due to the preincubation is not altered significantly by O_2. The increase of spontaneous breaks during the preincubation is almost completely prevented

by addition of either $NaBH_4$ or NH_2OH after the irradiation. The treatment can be before or after the preincubation. This effect indicates that these breaks are due to alkali-labile bonds possibly produced by depurination or depyrimidination reactions. That the spontaneous breaks are due primarily to alkali-labile bonds is supported by an experiment in which formamide gradients were used. Neither $NaBH_4$ nor NH_2OH has any effect on the enzyme sensitive sites. Addition of β-mercaptoethanol (0.5 M) at the start of the preincubation prevents in part the appearance of both spontaneous breaks and enzyme-sensitive sites. It has no effect when added at the end of the preincubation. Catalase added before the preincubation has no effect on either type of damage. It is postulated that the spontaneous breaks occur because purine or pyrimidine radicals are formed (possibly hydroxyl radicals) which can then interact with oxygen to produce unstable intermediates. These intermediates then undergo either depurination or depyrimidination. The subsequent alkali catalyzed β-elimination reaction of depurinated or depyrimindinated DNA is prevented by $NaBH_4$ or NH_2OH. An alternative hypothesis would involve damage to the sugar rather than to bases. The enzyme-sensitive sites represent another form of base damage which is not oxygen dependent. The chemical nature of either form of primary damage is not known. (auth)

29805 TOLUIDINE-BLUE METACHROMASIA IN DESOXYRIBONUCLEIC ACID FOLLOWING X-RAY IRRADIATION AND THE ACTION OF 2,4,6-TRIETHYLENE-IMINO-1,3,5-TRIAZINE. Tempel, K.; Ozdy, A. (Muenchen Univ. (F. R. Germany). Inst. fuer Pharmakologie, Toxikologie und Pharmazie). Strahlentherapie; 148: No. 4, 424-431(Oct 1974). (In German).

4 figs.; 2 tabs.; 40 refs.

The metachromatic activity of high-molecular thymus DNA measured with toluidine blue (TB) at 555 nm showed a dose-dependent drop on x-ray irradiation (150 to 5,200 rod) in vitro. The relative viscosity of DNA was reduced under identical conditions, whereas its elutability from DEAE cellulose columns increased. The metachromatic activity of the spleen and thymus SNA in mice was significantly reduced below that of the controls 4 to 6 hours after whole-body x-ray irradiation or i.v. injection of 5 to 20 mg 2,4,6-triethyleneimino-s-triazine (TEM) which is indicative of biochemical decomposition processes. Doses of 600 to 1,200 rad or 10 to 20 mg/kg TEM were determined by column chromatography, and those of 127 to 1,020 rad or 20 mg TEM/kg body weight by viscometry. The results obtained with liver DNA were less uniform and interpreted in terms of decomposition and repair processes. While the metachromatic activity of DNA on TB can be used in vitro as a non-specific but sensitive, simple and rapid indicator of radiation damage, the method is inferior to other measuring procedures as regards specifity and sensitivity when carried out in vivo. (auth)

29806 RADIOSENSITIVITIES OF DNA MOLECULES IN LYMPHOCYTES FROM THE CIRCULATING BLOOD OF MAN. Hashimoto, Y.; Ono, T.; Okada, S. (Tokyo Univ.). Blood; 45: No. 4, 503-509(Apr 1975).

The radiosensitivities of DNA molecules from lymphocytes of human circulating blood were examined by alkaline sucrose gradient centrifugation. The single-strand breaks of DNA per rad, including the breaks formed under the present alkaline condition, were 1.2 ± 0.1 breaks per 10^{12} daltons DNA per rad. When the cells were transformed, the number of breaks was found to increase to 1.8 ± 0.2 breaks per 10^{12} daltons DNA per rad. The lymphocytes are capable of rejoining radiation-induced single-strand breaks of DNA. The rate of rejoining was dependent on types of the suspending medium. The rate increased to ten times that of the nontransformed cells upon transformation. (auth)

29807 INACTIVATION OF TRANSFECTING DNA BY PHYSICAL AND CHEMICAL AGENTS: INFLUENCE OF GENOTYPES OF PHAGE LAMBDA AND HOST CELLS. Bresler, S. E.; Kalanin, V. L.; Shelegedin, V. N. (Inst. of Nuclear Physics, Leningrad). Mutat. Res.; 25: No. 3, 235-248(Dec 1974).

Inactivation of phage λ and its purified DNA by uv irradiation, γ rays of ^{137}Cs (in conditions of indirect action), nitrous acid, hydroxylamine and N-methyl-N'-nitro-N-nitrosoguanidine (MNNG) was studied. The biological activity of isolated phage DNA was measured by the calcium transfection procedure. Fourteen different recipient strains of Escherichia coli K12 were used, including mutants deficient in excision and recombination repair. Whole phage was more resistant to the action of γ rays than was isolated DNA. On the other hand, the chemical agents HNO_2 and MNNG inactivated phage much faster than isolated DNA. Of all mutations of the host cell only polA1 considerably increased the sensitivity of phage DNA to uv irradiation, γ rays, and MNNG. The mutations uvr^- affected the inactivation kinetics under uv action. In all other cases the genotype of the host cell was indifferent for the inactivation kinetics of phage DNA, even if it belonged to the recombination deficient mutant (in which only uv and γ inactivation was studied). Possible reasons for the low efficiency of the host-cell repair toward the damage caused to λ DNA by different agents are discussed. (auth)

Radiation Effects on Cells

Refer also to abstracts 29868–29872, 29916, and 29917.

29808 (BNWL-SA-5279) DOSE-RATE AND FRACTIONATION EFFECTS OF IONIZATION RADIATION. Roesch, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 10 Jan 1975. Contract AT(45-1)-1830. 10p. Dep. NTIS $4.00.

A number of theories and models that have been considered to explain the relationship of radiation dose rate and dose fractionation to biological radiation effects are discussed. The effects of dose rate and dose fractionation on the survival curves of mammalian cells in synchronized cultures and of the green algae, Chlamydomas reinhardi, exposed under either air or nitrogen are reviewed. The effects of mitotic stage during the cell cycle on the radiosensitivity of cells and the role of biological recovery in cell survival are discussed. (CH)

29809 (JPRS-64360) MOLECULAR PRINCIPLES OF HIGH-ENERGY HADRON ACTION AND RESULTS OF BIOLOGICAL RESEARCH IN SPACE. Akoev, I. G.; Yurov, S. S. Translated from Izv. Akad. Nauk SSSR, Ser. Biol.; No. 1, 11-24(1975). 20p. NTIS.

A review is presented of the somatic and genetic action of high-energy hadrons on Vicia faba root cell survival and chromosome aberration number, survival of E. coli, and mutagenesis of bacteriophages, and some physical and molecular principles defining features of the biological effects they evoke, as well as results of experiments conducted in space and in high-energy accelerators. (auth)

29810 (MBL–1974-6) USE OF UV ENDONUCLEASE FROM MICROCOCCUS LUTEUS TO MONITOR THE PROGRESS OF DNA REPAIR IN UV-IRRADIATED HUMAN CELLS. Paterson, M. C.; Lohman, P. H. M.; Sluyter, M. L. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. TNO). 1974. 29p. INIS.

A sensitive enzymatic assay was developed to follow the progress of DNA repair in human cells exposed to ultraviolet (uv) radiation. The assay employs an endonuclease selectively active at sites containing pyrimidine dimers in uv-damaged DNA. Primary fibroblasts are exposed to 254 nm radiation and incubated for specified times, their radioactively labelled DNA is isolated and treated with a uv endonuclease extensively purified from Micrococcus luteus. Endonuclease-susceptible sites remaining in the DNA are subsequently observed as single-strand scissions by sedimentation in alkaline sucrose gradients. In comparison to the situation with excision-proficient normal cells, those derived from patients suffering from either the classical or the De Sanctis-Cacchione clinical form of Xeroderma pigmentosum (XP) exhibit a marked diminution in the rate of disappearance of nuclease-susceptible lesions with time of post-uv incubation. (NL)

29811 (ORO-3646-25) COMPARATIVE STUDY OF RADIATION, CHEMICAL, AND AGING EFFECTS ON VIRAL TRANSFORMATION. Annual Progress Report. Coggin, J. H. Jr. (Tennessee Univ., Knoxville (USA). Dept. of Microbiology). 1 Apr 1975. Contract AT(40-1)-3646. 23p. Dep. NTIS $4.25.

Progress is reported on experiments to better understand how tumor viruses regulate and control the expression of embryo associated cellular products as an integral activity in transforming normal cells. These studies are feasible because exposure of normal target cells to sublethal x-irradiation greatly sensitizes the cells to viral oncogenesis. It was observed that coordinate with the induction of neoplastic characteristics in viral transformed cells, embryonic moieties (antigens-EA) appear in the plasma membrane of the tumor cells and act as autoantigens. Radiation (25 to 350 R) alone does not cause transformation of normal hamster or human cells in vitro, however, these levels of exposure do promote 50 to 1000-fold increases in viral oncogenesis induced by oncodnaviruses. It was demonstrated that early embryo tissue of the hamster, mouse, and human possess antigens (EA) which are identical to those occurring on viral transformed cells. During the terminal stages of embryonic or fetal development in vivo these antigenic entities are masked by biochemical processes associated with membrane maturation and subsequently reside cryptically in adult cell membrane. Viral

oncogenesis serves to cause defective biosynthesis and results in the reexpression of EA. The central problem in the current work is to discover whether embryonic markers expressed at the cell surface can be successfully used to reliably detect the earliest stages of viral induced neoplastic traits in the tumor cells and by immunologic means to determine how low-level radiation serves to potentiate this virus-host cell interaction. (auth)

29812 (ORO-1761-1) REPETITIOUS NATURE OF REPAIRED DNA IN MAMMALIAN CELLS. Progress Report, June 1, 1974–May 31, 1975. Meltz, M. L. (Southwest Foundation for Research and Education, San Antonio, Tex. (USA)). Feb 1975. Contract AT(40-1)-4761. 39p. Dep. NTIS $5.00.

Progress is reported on studies of the effects of uv radiation, methyl methanesulfonate, and benz(α) pyrene on DNA synthesis and replication in cultured mammalian cells. Data are reported on the effects of uv radiation on the levels of DNA precursor uptake and incorporation in L cells immediately after irradiation and the extent of DNA repair replication as a function of radiation dose and time after a single exposure. (CH)

29813 (SGAE-2360) DNA-REPAIR AND DNA-ANTIBODIES DURING EXPERIMENTAL MYCOPLASMA ARTHRITIS. Klein, G.; Wottawa, A.; Streit, S.; Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Sep 1974. 8p. (CONF-731215-5; BL-116/74). Dep. NTIS (US Sales Only) $4.00.

From international symposium on DNA-repair and late effects; Vienna, Austria (6 Dec 1973).

To clarify the pathogenesis of a mycoplasma induced arthritis in rats investigations were carried out on the influence of mycoplasma infection on DNA repair following gamma irradiation and the occurrence of DNA antibodies. During acute and subacute stage of the experimentally induced arthritis an inhibition of DNA repair could be observed. Besides the results indicated a correlation between reduced or inhibited DNA repair and the appearance of DNA antibodies could be found. (auth)

29814 K VALUES AND GAIN FACTORS OF FAST NEUTRONS AND X-RAYS FOR A MAMMALIAN CELL SYSTEM (CFU) IN VIVO. Hendry, J. H.; Gilbert, C. W.; Howard, A. (Christie Hospital, Manchester, Eng.). Radiat. Res.; 61: No. 3, 504-512 (Mar 1975).

The relationship between radiosensitivity and oxygen tension is defined by two parameters; m, the maximum ratio of radiosensitivity obtained by variation of the oxygen tension, and K, the oxygen tension at which the radiosensitivity equals $(m + 1)/2$. It is shown here that the ratio of K values for two radiations, e.g., x rays and neutrons, can be determined from the sensitivities of cells in anoxic, well-oxygenated, and one intermediate condition, irrespective of the absolute oxygen tension of the latter. For mouse bone marrow stem cells irradiated in dead mice and in mice breathing air or breathing 5.8% O_2 in N_2, the ratio K_x/K_n was 1.46 ± 0.45. This ratio implies a Gain Factor for neutrons, with respect to cells at low (but not zero) oxygen tension, which is slightly greater than that expected if K_x is less than, or equals, K_n. The findings are discussed with reference to fast-neutron radiotherapy. (auth)

29815 THE RESPONSE OF EHRLICH TUMORS TO FRACTIONATED IRRADIATION WITH FAST ELECTRONS: CONTRIBUTIONS OF FRACTION NUMBER AND TREATMENT TIME. Kozlov, A. P.; Akimov, A. A.; Pertsov, O. L. (N. N. Petrov Inst. of Oncology, Leningrad (USSR). Lab. of High Energies). Strahlentherapie; 148: No. 4, 404-408(Oct 1974).

The effect of fractionated irradiation schemes with the fraction numbers 4, 6, and 10 and treatment times of 5, 11, and 18 days to inhibit Ehrlich tumors is discussed. The dose at which 50% of the tumors are inhibited (ID 50), determined from the mean inhibition gain factor for 3 to 10 days after the course termination, is accepted as a quantitative criterion for the evaluation of the tumor inhibition effect of fast electrons. It is shown that an increase in treatment time results in a larger dose required to inhibit 50% of the tumors. The quantitative relationship of dose effect and treatment time is expressed by the power function with an index of 0.34. With a treatment time being the same (11 days), an immediate relationship between the tumor inhibition effect of fast electrons and fraction number is not observed. (auth)

29816 INHIBITION OF PROLIFERATION OF LYMPHOMA CELLS AND T LYMPHOCYTES BY SUPPRESSOR CELLS FROM SPLEENS OF TUMOR-BEARING MICE. Kirchner, H.; Muchmore, A. V.; Chused, T. M.; Holden, H. T.; Kerberman, R. B. (National Institutes of Health, Bethesda, MD). J. Immunol.; 114: No. 1, 206-210(Jan 1975).

Suppressor cells were found in spleens of mice bearing tumors induced by Moloney murine sarcoma virus (MSV) which were non-T cells and inhibited phytohemagglutinin Moloney (PHA)-induced DNA synthesis of syngeneic normal spleen cells. From the present study, the suppressor cells appeared to be macrophages since they were radioresistant, inactivated by carrageenan, and removed by adherence columns and an iron/magnet technique. Suppressor cells were still fully active when added 16 hr after the mitogen, thus indicating that early mitogen-induced changes were not the target of suppressive action. It appeared that suppressor cells inhibited metabolic events related to the initiation of DNA synthesis and that they had a selective effect on proliferation-dependent lymphocyte effector functions. PHA-induced cytotoxic reactivity which in our system is largely independent of DNA synthesis was not depressed but actually enhanced in MSV spleens. Cytotoxicity of MSV spleen cells against syngeneic lymphoma cells was unaffected by suppressor cells whereas lymphocyte stimulation by mitomycin C-treated syngeneic lymphoma cells was inhibited. MSV spleen cells also inhibited DNA synthesis of cultured murine lymphoma cells. This function was only slightly diminished after treatment with anti-θ serum plus guinea pig complement. Furthermore, spleen cells from MSV tumor-bearing nude mice were as effective as spleen cells from their heterozygous littermates, thus suggesting that T lymphocytes are not the main effector cells of inhibition of lymphoma cell DNA synthesis. The inhibitor cells were radioresistant, inactivated by carrageenan, and removed by adherence columns and the iron/magnet technique. These data strongly suggest that the inhibitor cells of lymphoma cell DNA synthesis are macrophages and that they belong to the same group of cells as the suppressor cells of PHA-induced lymphocyte proliferation. (auth)

29817 EFFECT OF QUINACRINE ON SURVIVAL AND DNA REPAIR IN X-IRRADIATED CHINESE HAMSTER CELLS. Voiculetz, N.; Smith, K. C.; Kaplan, H. S. (Stanford Univ., CA). Cancer Res.; 34: No. 5, 1038-1044(May 1974).

Quinacrine (5 μg/ml) sensitizes cultured Chinese hamster cells (A1 subline) to killing by x rays and inhibits the repair of single-strand breaks in their DNA. The relevance of the chemical inhibition of repair systems to the radiation treatment of cancer is discussed. (auth)

29818 SISTER CHROMATID EXCHANGES INDUCED IN CHINESE HAMSTER CELLS BY UV IRRADIATION OF DIFFERENT STAGES OF THE CELL CYCLE: THE NECESSITY FOR CELLS TO PASS THROUGH S. Wolff, S.; Bodycote, J.; Painter, R. B. (Univ. of California, San Francisco). Mutat. Res.; 25: No. 1, 73-81 (Oct 1974).

Experiments on the induction of sister chromatid exchanges (SCE's) by uv light show that, in Chinese hamster cells, these exchanges can be induced in any stage of the cell cycle. The effect is caused by the formation of persistent lesions that lead to exchanges only if the lesion-bearing chromosomes pass through S. UV light can induce exchanges in cell lines that carry out DNA repair replication efficiently as well as in a cell line that shows little or no repair. The induction of SCE's by uv light thus seems to be independent of DNA repair replication. Post-replication repair might be responsible for the formation of the exchanges, but they encompass longer switches of label than have been observed for this type of repair. (NL)

Radiation Effects on Microorganisms

Refer also to abstracts 29787, 29793, 29799, 29800, and 29807.

29819 (ORO-4568-5) ROLE FOR DNA LIGASE IN DNA POLYMERASE I–DEPENDENT REPAIR SYNTHESIS IN TOLUENE-TREATED ESCHERICHIA COLI. Billen, D.; Hellermann, G. R.; Stallions, D. R. (Tennessee Univ., Knoxville (USA)). 1974. 10p. Dep. NTIS $4.00.

The effects of x irradiation on DNA synthesis in toluene-treated Escherichia coli incubated at 30°C or 42°C were studied. The role of DNA ligase in the polymerase-dependent repair of radiation injuries was studied. (CH)

29820 PHYSICAL, CHEMICAL, AND MORPHOLOGIC DIMENSIONS OF HUMAN HEPATITIS A VIRUS STRAIN CR326. Provost, P. J.; Wolanski, B. S.; Miller, W. J.; Ittensohn, O. L.; McAleer, W. J.; Hilleeman, M. R. (Merck Inst. for Therapeutic Research, West Point, PA). Proc. Soc. Exp. Biol. Med.; 148: No. 2, 532-539(Feb 1975).

CR326 human hepatitis A virus purified by isopycnic banding from infected marmoset sera was shown to consist of 27 nm spherical particles on electron microscopic examination. The particles were identified as hepatitis A virus by tests for infectivity and by specific neutralization of infectivity with convalescent human hepatitis A serum. Also, identical 27 nm viruses in

liver extracts gave specific reactions with hepatitis A antisera when tested by immune electron microscopy. The buoyant density of the virus in CsCl was 1.34 and it was heat (60°), ether and acid stable but was destroyed by heat (100°), formalin (1:4000) and ultraviolet irradiation. Electron microscopic studies of sections of infected marmoset liver showed intracytoplasmic virus particles, usually in vesicles. Presumptive findings for RNA, together with the intracytoplasmic location of the virus, indicated the virus to be of RNA-type. The attributes of the virus indicate it is closely related to the enterovirus family and not to hepatitis B virus. (auth)

29821 CATABOLITE REPRESSION OF L-ARABINOSE ISOMERASE IN ESCHERICHIA COLI INDUCED BY ULTRAVIOLET IRRADIATION. Bhattacharya, A. K. (Banaras Hindu Univ., India). Biochim. Biophys. Acta; 354: No. 1, 71-74(Jun 1974).

The inhibition of L-arabinose isomerase synthesis in Escherichia coli B/r by ultraviolet irradiation could be partially reversed by cyclic AMP, the reversal being dependent on the concentration of the nucleotide. The increased rate of enzyme synthesis by cyclic AMP in ultraviolet light irradiated cells became evident within a short period following its addition. Rifampin completely blocked this stimulatory action of the cyclic nucleotide, indicating that the catabolite repression of L-arabinose isomerase by ultraviolet irradiation is regulated at the level of transcription. (NL)

29822 INDUCTION OF NUTRITIONAL MUTANTS OF MICROCOCCUS GLUTAMICUS AND THEIR AMINO ACID ACCUMULATION. Banik, A. K.; Majumdar, S. K. (Jadavpur Univ., Calcutta). Folia Biol. (Prague); 20: No. 1, 38-45(1975).

Micrococcus glutamicus ATCC 13032, a glutamic acid-producing organism, was treated with 0.2M ethylmethane sulfonate, the auxotrophs isolated showing varied patterns of extracellular amino acids. Eighty auxotrophic strains were obtained, out of which 31 excreted 1.0 to 4.0 mg threonine per ml and all the auxotrophs required biotin for growth and production of the amino acid. Eleven auxotrophs produced 1.5 to 3.0 mg alanine per ml and these auxotrophs required amino acids for their growth. Other auxotrophs lost their excretion capacity in subsequent fermentation trials. Further mutation of the biotin-requiring auxotroph Micrococcus glutamicus EM with gamma rays resulted in the isolation of 89 auxotrophic strains out of which 28 excreted threonine (up to 5.0 mg per ml) higher than the parent auxotroph. Exposure to x rays yielded 97 auxotrophs, out of these 35 producing 1.0 to 3.0 mg methionine per ml and requiring biotin for growth and production of the amino acid. Other auxotrophs produced alanine (0.5 to 2.0 mg per ml) and threonine (2.0 to 3.3 mg per ml). Irradiation with gamma rays favored the development of threonine producing auxotrophs while x rays favored methionine-producing auxotrophs. (auth)

29823 TEMPERATURE-SENSITIVE RECA MUTANT OF ESCHERICHIA COLI K-12: DEOXYRIBONUCLEIC ACID METABOLISM AFTER ULTRAVIOLET IRRADIATION. Hall, J. D.; Howard-Flanders, P. (Yale Univ., New Haven). J. Bacteriol.; 121: No. 3, 892-900(Mar 1975).

A mutant of Escherichia coli K-12 temperature sensitive for genetic recombination was investigated and found to carry a mutation that could be cotransduced with cysC and hence could be in the recA gene. To determine whether $recA^+$ can complement this mutation, matings were carried out at 35 and 40°C between Hfr donors that transfer $recA^+$ or recA1 early and recipients carrying wild-type or mutant alleles. It was found that $recA^+$ but not recA1 complements this mutation in zygotic temporary partial diploids. The mutant allele was accordingly designated recA44. A transductant carrying recA44 behaved normally at low temperatures but more like $recA^-$ strains at high temperatures with respect to recombinant colony formation in Hfr matings, cell survival, and deoxyribonucleic acid (DNA) synthesis after ultraviolet irradiation, cellular DNA breakdown, and prophage induction when lysogenic for λ. Alkaline sucrose sedimentation studies of DNA from recA44 cells showed that short DNA molecules synthesized immediately after ultraviolet irradiation increased in molecular weight during subsequent incubation at 32°C but not at 45°C. Hence, rec A^+ is required for this molecular weight increase. Cells exposed to ultraviolet light synthesized DNA that remained of low molecular weight during a 40-min incubation at 32°C. This material increased in molecular weight in $recA^+$ but not in recA44 cells during subsequent incubation at 45°C. Thus, the availability of $recA^+$ during the first 40 min at 32°C after irradiation did not obviate the need for $recA^+$ in the subsequent phases of this post-replication repair process. (auth)

29824 DOSE DEPENDENCE OF THE EXCISION OF ULTRAVIOLET-INDUCED PYRIMIDINE DIMERS FROM NUCLEAR DEOXYRIBONUCLEIC ACIDS OF HAPLOID AND DIPLOID SACCHAROMYCES CEREVISIAE. Waters, R.; Moustacchi, E. (Institut du Radium, Orsay, France). J. Bacteriol.; 121: No. 3, 901-906(Mar 1975).

The yield of ultraviolet-induced dimers is similar for a fixed dose in both haploid and diploid Saccharomyces cerevisiae. The excision of these photoproducts from the nuclear deoxyribonucleic acids of cells of both ploidies after ultraviolet incident doses of 2×10^3 to 4×10^3 ergs/mm^2 decreased with the corresponding increasing dose. Postirradiation incubation in saline followed by a further incubation in nutrient medium increases the excision as compared to that seen in either nutrient medium or saline alone. Previous data regarding both pyrimidine dimer removal and the survival of haploid and diploid cells after ultraviolet irradiation and either immediate or delayed plating are discussed. (auth)

29825 EFFECT OF TSL MUTATIONS IN DECREASING RADIATION SENSITIVITY OF A $RECA^-$ STRAIN OF ESCHERICHIA COLI K-12. Mount, D. W.; Walker, A. C.; Kosel, C. (Univ. of Arizona, Tucson). J. Bacteriol.; 121: No. 3, 1203-1207(Mar 1975).

It has been shown previously that the radiation sensitivity of $lexA^-$ strains of Escherichia coli K-12 can be suppressed by thermosensitive mutations (designated tsl) that are closely linked to the lexA locus and are thought to be intragenic suppressors of lexA mutations (Mount et al., 1973). When a recA mutation is crossed into a suppressed tsl^- strain, the extreme radiation sensitivity usually conferred by a recA mutation is decreased, but there is no detectable change in genetic recombination deficiency. Increased resistance to UV in the tsl^-recA^- strains depends upon ability to synthesize active $uvrA^+$ product. (auth)

29826 IRRADIATION OF SERRATIA MARCESENS BY SINGLE AND DOUBLE PULSES OF HIGH-INTENSITY ELECTRONS: OXYGEN DIFFUSION KINETICS AND LIFETIME OF OXYGEN-SENSITIVE SPECIES. Weiss, H.; Ling, C. C.; Epp, E. R.; Santomasso, A.; Heslin, J. M. (Sloan-Kettering Inst. for Cancer Research, New York). Radiat. Res.; 61: No. 3, 355-365(Mar 1975).

Breaking survival curves were measured for Serratia marcescens on Millipore filters equilibrated with known oxygen concentrations and irradiated by single pulses at ultrahigh dose rates. This phenomenon is attributed to the radiochemical depletion of intracellular oxygen and provides a basis for double-pulse experiments conducted to measure diffusion of oxygen in irradiated cells. A first pulse with sufficient dose to deplete intracellular oxygen precedes a similar second pulse by an accurately known interpulse time, variable from 10^{-6} sec to 30 sec. The amount of oxygen diffusing to critical sites in the cell during the interpulse time is inferred by comparison to cellular response measured under various oxygen concentrations with single high-intensity pulses. Oxygen-diffusion curves obtained show that a significant amount of oxygen diffuses to these sites by 10^{-4} sec. This can be interpreted as an upper limit to the lifetime of the radiation-induced oxygen-dependent damage. This limit is in agreement with that previously obtained by this laboratory for E. coli B/r using the double-pulse technique, but it is five times shorter than the half-life of oxygen-dependent damage found for Serratia marcescens by another laboratory which employed a fast-mixing technique. (auth)

29827 SEMI-COMMERICAL IRRADIATION OF ONIONS IN THAILAND. Loaharanu, P. (Office of Atomic Energy for Peace, Bangkok (Thailand). Biological Sciences Div.). Food Irradiat. Inform.; No. 3, 10-13(Jun 1974).

In Thailand, the Ministry of Public Health granted permission on March 20, 1973 for onions irradiated with a dose of not more than 10 Krad to be sold to the public. From 1970 to 1972, the OAEP carried out research on sprout inhibition of onions by gamma irradiation. The onions were harvested manually, cured, packed, and stored in an air-conditioned room until irradiation. They were irradiated with a Gammabeam-650 irradiator. Fricke dosimetry was used to measure the absorbed dose. The production of irradiated onions was slightly over 1 ton/h. The cost was previously fixed at 12 per ton. The onions were stored at 5 to 10°C with relative humidity of 70 to 80%. After 3 months of storage, about 80% of the irradiated onions was marketable compared to 30% of the control samples. In Thailand, the future of this process appears promising. (GE)

29828 STERILIZATION OF FROZEN AND POWDERED EGGS BY IONIZING RADIATIONS. Morre, J. (Laboratoire Central d'Hygiene Alimentaire, 75 - Paris (France). Section Radiobiologie). Food Irradiat. Inform.; No. 3, 14-19(Jun 1974). (In French).

Some methods are outlined by which frozen and powdered eggs

can be sterilized. The use of irradiation (radicidation) for this purpose is discussed in more detail. The advantages of this method are demonstrated in comparison with the more usual practice of thermopasteurization. Wholesomeness tests carried out to date in France and the United Kingdom are briefly surveyed. The potential industrial applications are briefly discussed in addition to economic and legislative considerations. (GE)

29829 ASSESSMENT OF IRRADIATED FOODS FOR TOXICOLOGICAL SAFETY. Newer Methods. Chauhan, P. (Bhabha Atomic Research Centre, Bombay (India). Biochemistry and Food Technology Div.). Food Irradiat. Inform.; No. 3, 20-38 (Jun 1974).

Some of the procedures that can be adopted for in vivo testing in mammals are discussed. Techniques for the detection of possible teratogenic, mutagenic, and carcinogenic effects of irradiated foods are reviewed in more detail. The implications of induced microsomal enzyme activity are briefly discussed. (GE)

29830 PROGRESS IN FOOD IRRADIATION. Belgium. Food Irradiat. Inform.; No. 3, 39-44(Jun 1974).

A short review is presented on the radiation sources and the dosimetry. The observed radiation-induced chemical effects in irradiated foods such as shrimps, egg products, fruits and vegetables, potatoes, and grain and in food components are reviewed more in detail. Further, results on the microbiological effects of irradiation are demonstrated and the economic aspects are discussed. (GE)

29831 PROGRESS IN FOOD IRRADIATION. France. Food Irradiat. Inform.; No. 3, 45-59(Jun 1974). (In French).

A short review is given on the radiation sources used and the dosimetry. The radiation-induced chemical changes in starch are reviewed in detail. The effects on the microbial contamination of humid maize grains, starch, and shrimps with special emphasis on the genus Aspergillus are enumerated. Further, tests for identification of irradiated foods and new legislation are reported. The review concludes with a list of institutions concerned with the radiopreservation of food. (GE)

29832 PROGRESS IN FOOD IRRADIATION. Germany. Food Irradiat. Inform.; No. 3, 60-70(Jun 1974).

After a short description of the radiation sources and the dosimetric technique used, a more detailed review is given on radio-induced chemical reactions and radiation microbiology of food. Then the radiation treatment of various commodities is described with special emphasis on fruits, vegetables, spices, meat and meat products, poultry, and egg products. Studies on the wholesomeness of irradiated food are reported. Methods for identification of irradiated foodstuffs are discussed. Finally, the new legislation and clearances, the economic feasibility, market trials, and consumer acceptance are reviewed. (GE)

29833 THE IDENTIFICATION OF IRRADIATED FOODSTUFFS. A Report on an International Colloquium Held in Karlsruhe, F. R. Germany. Food Irradiat. Inform.; No. 3, 71-74(Jun 1974).

From international colloquium: The identification of irradiated foodstuffs; Karlsruhe, F. R. Germany (24 Oct 1973). Papers issued as AED-Conf-73-508.

A short report is given on lectures given at the International Colloquium. Altogether, 24 papers were presented. The main objective has been to study ways in which irradiation-induced changes in the foodstuffs could be used to develop practical analytical methods to identify whether a food has been irradiated or not. (GE)

29834 SPROUT INHIBITION IN YAM BY GAMMA IRRADIATION. Rivera, J. R.; Gonzalez, M. A.; Cuevas-Ruiz, J. (Univ. of Puerto Rico, Rio Piedras). Contract AT(40-1)-1833. J. Agr. Univ. Puerto Rico; 58: No. 3, 330-337(Jul 1974).

The effects of gamma irradiation on sprouting and on the chemical changes which take place in "Florido" variety of Dioscorea alata yam tubers grown in Puerto Rico were investigated. Irradiation with 7.5-Krad doses did not have appreciable effects on the chemical composition of the tubers but prolonged their dormancy period by 4 additional months. It is suggested that 7.5 Krad is the optimum dose for the inhibition of sprouting in this variety of yam. This treatment makes possible the availability of good quality yam tubers out of season. The loss in weight of the treated tubers was relatively low. Irradiated tubers were found very acceptable by sensory evaluation. (auth)

29835 ULTRAVIOLET MUTAGENESIS AND ITS REPAIR IN AN ESCHERICHIA COLI STRAIN CONTAINING A NONSENSE CODON. Person, S.; McCloskey, J. A.; Snipes, W.; Bockrath, R. C. (Pennsylvania State Univ., University Park). Genetics; 78: No. 4, 1035-1049(Dec 1974).

Ultraviolet mutagenesis and its repair were studied mainly in WU36-10-89, a uvr⁻ strain of Escherichia coli containing a UAG mutation in a gene for leucine biosynthesis. Following ultraviolet (uv) irradiation revertants appearing with or without direct photoreactivation (PR) were classified according to the presence and type of suppressor they contained. Mutation production was found to be quite specific. An analysis of revertants produced by uv indicates they are formed mainly from GC → AT and that the miscoding is due to a cytosine residue at the site of mutation in a cytosine-thymine (CT) dimer. It is proposed that the dimer serves as template during some aspects of repair replication and at the time of replication the C in the dimer directs the insertion of A in the complementary strand. The C → A and T → G changes caused by a CT dimer occur much less frequently. (auth)

29836 ROLE OF WATER IN ULTRAVIOLET-RESISTANCE OF GERMINATING BACTERIAL SPORES. Irie, R.; Morichi, T. (National Inst. of Animal Industry, Chiba (Japan)). J. Gen. Appl. Microbiol. (Tokyo); 19: No. 6, 421-427(Dec 1973).

Germinating spores of Bacillus subtilis were freeze-dried and irradiated with ultraviolet rays (uv) while dry or after rehydration. It was found that the extremely high uv-resistance of the spores in the transient stage, through which germination proceeds, is lost by freeze-drying and is rapidly restored by rehydration. (auth)

29837 PROPERTIES OF uvrE MUTANTS OF ESCHERICHIA COLI K12. I. Effects of uv Irradiation on DNA Metabolism. van Sluis, C. A.; Mattern, I. A.; Paterson, M. C. (Rijksuniversiteit, Leiden). Mutat. Res.; 25: No. 3, 273-279(Dec 1974).

Escherichia coli K12 uvrE is a mutator strain which is highly sensitive to ultraviolet radiation. In an attempt to determine the underlying molecular basis for the uv sensitivity, a mutant and an isogenic wild type strain are compared with regard to several metabolic responses to 254-nm radiation. The introduction of single-strand breaks into intracellular DNA after irradiation is normal. However, the rate of excision of pyrimidine dimers as well as of DNA degradation and final rejoining of the strand breaks is lower in the mutant as compared to the repair proficient strain. (NL)

29838 PROPERTIES OF uvrE MUTANTS OF ESCHERICHIA COLI K12. II. Construction and Properties of Pol and Rec Derivatives. Mattern, I. E.; Houtman, P. C. (Rijksverdedigingsorganisatie TNO, Rijswijk, Netherlands). Mutat. Res.; 25: No. 3, 281-287(Dec 1974).

Viability and sensitivity to uv- and x-radiation in double and single mutant strains of Escherichia coli are compared. The frequency of spontaneous mutations in double mutants is compared with that of the parent strain. (NL)

29839 DARK RECOVERY OF UV-IRRADIATED PHAGE T1. II. Interpretation of the Survival Kinetics Obtained Under Conditions of Host-Cell Reactivation. Harm, W. (Univ. of Texas, Dallas). Mutat. Res.; 25: No. 1, 3-14(Oct 1974).

Ultraviolet-irradiated T1 phages infecting excision-repair-proficient Escherichia coli cells undergo host-cell reactivation (HCR). Typically, the resulting survival curve is of a hetero-component type, i.e., extrapolation of the shallower curve component to zero uv dose gives ordinate values $p < 1$. This characteristic is accentuated if HCR is inhibited by uv irradiation of host cells prior to phage infection, or by the presence of caffeine or acriflavine. With increasing strength of the inhibitory conditions, p decreases and the slope of the steeper curve component increases, but the slope of the shallower curve component changes very little. In contrast, single-component curves are observed for T1 infecting excision-repair-deficient host cells, or for T1 undergoing photoenzymatic repair in these cells either with or without inhibition by caffeine or preirradiation of host cells. This indicates that throughout the population uv lesions are photorepaired or photorepair-inhibited independently of one another. Discussion of various possible interpretations of the hetero-component curves in the case of HCR suggests the existence of two modes of excision repair, one of them leading to a high degree of interdependence between repair events within individual phage particles. This mode of repair, which determines the slope and position of the shallower curve component, requires within an infected cell the occurrence of a critical event, whose probability is considerably lower than 1 and decreases with the strength of HCR inhibition. The other mode, leading to independent repair events, is of minor importance under the usual plating conditions, but plays a predominant role in liquid-holding recovery of the phage. (NL)

29840 MARKER RESCUE FROM UV-IRRADIATED BACTERIOPHAGES: A UV-SENSITIVE REGION IN BACTERIOPHAGE T2. de Goede, P.; van der Voort-Molema, L. (Rijksuniversitit, Leiden). Mutat. Res.; 25: No. 3, 249-261(Dec 1974).

Marker rescue was studied with T2 and T4 phage strains (wild type) as irradiated donor strains and mutants T2am39rIIA or

T2am47gt29am55 as helper strains. After selection of one marker from the donor strain, the frequency of the second donor marker was determined (corescue frequency). Corescue frequencies decreased with increasing doses of uv irradiation. In the region am47-am55 there was no difference between frequencies of corescue from T2 and T4 as donor strains. In the region am39-rIIA, frequencies of corescue from T2 were much lower than from T4 and could be ascribed to rescue of the two markers by independent rescue events. To explain the difference between T2 and T4, the following possibilities were investigated: 1) protection of a uv-sensitive site in T4 by a T4 gene product; 2) influence of partial exclusion of helper strain T2 by T4, and 3) a difference between T2 and T4 with respect to uv sensitivity in the region am39-rIIA. The first possibility could be rejected. Exclusion might play a minor role in corescue from T4. Probably, the region am39-rIIA in T2 is more susceptible to uv damage than in T4, presumably owing to a higher content of potential thymine dimers. The mean lengths of rescued DNA fragments at various doses of uv irradiation were estimated by using the observed corescue frequencies. Extrapolation of the relation between uv dose and length of rescued DNA fragments predicts a uv dose of 360 to 530 PLH required for rescue of DNA fragments of about two map units in the region of T4 gene αgt. (NL)

29841 INTERACTIONS OF THE excrA MUTATION WITH rec MUTANTS OF ESCHERICHIA COLI K12. Donch, J.; Greenberg, J. (Palo Alto Medical Research Foundation, CA). Mutat. Res.; 25: No. 3, 263-271(Dec 1974).

Mutants of Escherichia coli K12 were constructed which carry the exrA mutation addition to the various recombination deficient mutations recA, recB, and recC. The double mutant containing the exrArecA genotype is found to be more sensitive to uv irradiation at very low doses of uv but essentially is very similar to the exrA$^+$ recA at the high uv doses. The recombination deficiency, λ induction, and DNA degradation of the exrArecA shows a slight increase in the defectiveness of each of these functions. The double mutants of exrArecB and exrArecC show an increase in uv sensitivity and recombination deficiency and λ induction. The DNA degradation following uv irradiation of these mutants is more characteristic of the recB and recC mutant alone. (NL)

29842 RADIOSENSITIVITY TO GAMMA RAYS OF SPORES OF A DNA POLYMERASE DEFICIENT MUTANT OF BACILLUS SUBTILIS. Terano, H.; Kadota, H. (Kyoto Univ.). Mutat. Res.; 24: No. 3, 379-381(Sep 1974).

29843 EFFECTS OF ETHIDIUM, QUINACRINE, AND HYCANTHONE ON SURVIVAL AND MUTAGENESIS OF UV-IRRADIATED HCR$^+$ AND HCR$^-$ STRAINS OF E. COLI B/r. Clarke, C. H. (East Anglia Univ., Norwich, Eng.); Shankel, D. M. Mutat. Res.; 26: No. 6, 473-481(Dec 1974).

Ethidium, quinacrine, or hycanthone when incorporated in the post-irradiated plating medium have all been found to decrease survival and increase str^r mutation frequencies in a uv-irradiated Escherichia coli B/r strain. The enhancement of mutational yield was shown, for quinacrine, to apply also to uv-induced trp$^-$ → Trp$^+$ reversions. Since these three compounds do not enhance mutational yields, and have at best only a weak antimutagenic action, in an Hcr$^-$ strain, it seems probable that ethidium, quinacrine, and hycanthone are primarily inhibitors of excision repair. (NL)

29844 INFLUENCE OF CELLULAR SUSCEPTIBILITY TO AMPHOTHERICIN B AND OF POST-IRRADIATION GROWTH CONDITIONS ON INACTIVATION OF CANDIDA ALBICANS BY ULTRAVIOLET RADIATION. Sarachek, A.; Pettriess, R. W. (Wichita State Univ., Kansas). Mycopathol. Mycol. Appl.; 54: No. 2, 205-214(Nov 1974).

Inactivation of non-budding cells of Candida albicans by ultraviolet radiation is determined in part by 1) their post-irradiation incubation temperature, 2) opportunity for exposure to long chain fatty acids or sterols, and 3) the nutritional quality of their post-irradiation growth medium. These cultural conditions do not affect the viability of cells which are budding when irradiated nor the frequency of mutants among the survivors of irradiated, unbudded populations. Several lines of evidence have indicated that the post-irradiation growth conditions influence recoveries from non-genetic forms of uv-induced damage which are potentially lethal only for cells which are not in the process of division when irradiated. Studies reported here show that mutation to resistance to the polyene antibiotic, amphotericin B, changes the composite pattern of survival responses of uv-treated unbudded cells to the three post-irradiation conditions. Acquisition of amphotericin B resistance does not alter the uv mutability of such cells nor the vulnerability of budding cells to uv inactivation. Differences in susceptibilities of cells to polyene antibiotics are known to be determined by differences in the composition and structural arrangement of their membranes. The present observations are consonant with a previous proposal that post-irradiation temperature, nutrition, and contact with lipid affect cellular recoveries from damages to processes which 1) are essential for initiation of cell division and 2) are related to the organization of the cell membrane. (NL)

29845 REPAIR SYSTEMS IN SACCHAROMYCES. Cox, B.; Game, J. (Botany School, Oxford). Mutat. Res.; 26: No. 4, 257-264(Aug 1974).

From 1st international conference on environmental mutagens; Asilomar, CA (19 Aug 1973).

Radiation-sensitive mutations of yeast in multiple-mutant combinations interact with one another to affect survival. From these interactions and from the effects of these mutations on other genetic events such as recombination or mutation, it is possible to deduce a scheme representing the pathways by which repair is effected. The biochemical roles of these pathways can be determined by simple assay systems. For example, one pathway controlled by four loci is concerned with the early stages of excision of pyrimidine dimers. Some of the loci used in this investigation affect the rate and quality of uv-induced mutation and so indicate what part repair might play in this process. (NL)

Radiation Effects on Plants

Refer also to abstracts 32394 and 32399.

29846 (ORO-4182-5) DIFFERENTIAL GENE EXPRESSION IN NEUROSPORA CRASSA CELL TYPES. Progress Report, April 1, 1974–March 31, 1975. Dutta, S. K. (Howard Univ., Washington, D. C. (USA)). 1975. Contract AT(40-1)-4182. 6p. Dep. NTIS $4.00.

The significant results obtained during the fifth year of the present research program are as follows: representatives of broad groups of fungi tested contained 10 to 20% repeated DNA sequences. These were approximately 4×10^7 dalton piece size of each and repeated 100 to 110 times. Heterothallic species of Neurospora and natural Neurospora isolates which were heterothallic were indistinguishable by morphology and DNA characteristics but could be clearly distinguished by DNA : DNA homology studies. Based on DNA homology studies, it was possible to assign a few wild collected isolates to species. Representative species from the monoflagellate Blastocladiales and the biflagellate Saprolegniales were studied for their DNA base composition, heterogeneity, nucleotide sequence homology and divergence. High A + T rich repeated DNA sequences were found to be interdispersed throughout the Neurospora chromosome. Purified whole RNA cistrons isolated from the wild type Neurospora crassa 74A mycelial cells reacted 92% with the wild type RNA but only 62 to 68% with the mutant RNAs. Thus transcriptional differences between mutant strains of N. crassa could be identified (which was not otherwise identifiable) using isolated wRNA cistrons. The slime mutant of N. crassa was found to be more resistant to cobalt-60 γ radiation in comparison to an albino mutant of N. crassa. (auth)

29847 CRITICAL PERIOD IN THE FORMATION OF RADIORESISTANT BARLEY SEEDS AT HIGH ALTITUDES. Pastushenko-Strelets, N. A.; Belova, T. V. (Inst. of Evolutionary Morphology and Ecology of Animals, Moscow). Zh. Obshch. Biol.; 36: No. 1, 100-106(1975). (In Russian).

To elucidate the reasons of a high radioresistance of barley seeds from the plants grown in high mountains and to establish in what period of ontogenesis radioresistance appears, field experiments were performed in the Western Pamir. The uv part of the natural solar radiation was excluded both during the whole vegetation period and at certain stages of plant development. The model experiment was made in chambers illuminated with different spectrum bulbs. The estimation of the chromosome aberration rate in the meristeme cells of the root tips of gamma-irradiated barley seed seedlings revealed that a high level of uv radiations is one of the main factors responsible for an increased resistance of barley seeds grown high in the mountains. The critical period of radioresistance formation is the interval between shooting and appearance of awn tips. (auth)

29848 EFFECT OF DEUTERIUM WATER ON THE MITOTIC CYCLE, THE DEOXYRIBONUCLEIC ACID STABILITY, AND THE FREQUENCY OF RADIATION-INDUCED CHROMOSOME ABERRATIONS IN BARLEY. Sideris, E. G.; Mukherjee, R.; Vomvoyanni, V. (Nuclear Research Center Democritos, Athens). Radiat. Res.; 61: No. 3, 457-467(Mar 1975).

Hordeum vulgare var. Himalaya seeds were irradiated with

gamma rays and hydrated in protium or deuterium water. The frequency of radiation-induced chromosome aberrations was lower in the deuterated material. The reduced frequency of chromosome aberrations was coupled with a delay of the early stages, an inhibition of the late stages of mitotic division, and an increase in the melting temperature (Tm) of the deoxyribonucleic acid. The decrease in the radiation-induced damage, in the presence of deuterium water, is attributed to the immobilization of the broken ends of the chromosomes due to the delay of the mitosis and the increased stability of the deoxyribonucleic acid molecule, both of them favoring the reconstitution of the broken ends. (auth)

29849 INDUCED MUTATION AND CHIMERA IN WOODY PLANTS. Report of a Symposium Held in Ohmiya, Japan, July 26–27, 1973. Gamma Field Symposia, Number 12. Ohmiya, Japan; Institute of Radiation Breeding (1973). 127p. (In Japanese and English). (CONF-730738–).

Separate abstracts were prepared for the seven papers presented at the symposium. (HLW)

For abstracts of individual papers see: 29850–29854, 32401, and 32402.

29850 INDUCTION OF THE SOMATIC MUTATIONS IN DECIDUOUS FRUIT TREES BY GAMMA IRRADIATION. Nishida, T. (Fruit Tree Research Station, Hiratsuka, Japan). Gamma Field Symp.; No. 12, 1-17(1973).

From gamma field symposia on induced mutation and chimera in woody plants; Ohmiya-machi, Japan (26 Jul 1973). See CONF-730748–.

Under chronic gamma irradiation, the frequency of detectable mutations was rather low so far as special treatment such as cutting back method was not applied. On the contrary, under semi-acute irradiation, the mutation frequency was higher, but it was feared that the induced mutants had some chromosomal aberrations and fertility of the mutants was reduced. Then, it might be preferable to cut back the chronically irradiated materials severely in order to enlarge the size of the mutated sector and to avoid the reduction of fertility of the induced mutants. (auth)

29851 INDUCTION OF SOMATIC MUTATION AND CROSS FERTILITY OF THE MUTANTS IN SUGI, CRYPTOMERIA JAPONICA D. DON. Ohba, K. (Kyushu Forest Tree Breeding Station, Kumamoto, Japan); Maeta, T. Gamma Field Symp.; No. 12, 19-36(1973).

From gamma field symposia on induced mutation and chimera in woody plants; Ohmiya-machi, Japan (26 Jul 1973). See CONF-730748–.

In sugi, Cryptomeria japonica D. Don, a varietal difference of somatic mutability was noted, and the somatic mutation rate and spectrum of the mutation were modified by such factors as root shielding from radiation, fertilization, exposure rate, total exposure, irradiation season, cutting back treatment, and the internal disbudding by radiation. As one of the techniques to induce somatic mutation in Kuma-sugi, irradiation in August (summer) was recommended to get a high frequency of mutation and various kinds of mutation. After re-irradiation of the somatic mutant clones and their control plants, waxless mutants produced higher rates of morphological somatic mutation; meanwhile morphological ones produced least mutation. In some of the mutants, pollen fertility, seed production per cone and seed germination were reduced greatly indicating chromosomal aberration in them. Fifty-two somatic mutant clones are preserved at the Institute of Radiation Breeding and brief explanations of their origin and traits are made. (auth)

29852 INDUCTION OF THE SOMATIC MUTATIONS IN TEA PLANTS BY GAMMA IRRADIATION. Nakayama, A. (National Research Inst. of Tea, Kanaya, Japan). Gamma Field Symp.; No. 12, 37-47(1973).

From gamma field symposia on induced mutation and chimera in woody plants; Ohmiya-machi, Japan (26 Jul 1973). See CONF-730748–.

Two- or three-year-old tea plants were planted in the gamma field of the Institute of Radiation Breeding at a distance of 11.5 to 98.5 m from the radiation source in April 1962 in order to obtain basic information for the induction of the somatic mutation in the tea plant under chronic irradiation. The 100 percent lethal exposure rate for the tea plants seemed to be 60 to 80 R/day in the third year of planting. Furthermore, the plant height decreased with proximity to the radiation source, and abnormal leaves or shoots without buds occurred frequently. Bud mutation was induced in the range of 22 to 55 m from the source. The survey on the frequency of the mutated shoots revealed that 20 to 30 R/day appeared to be the optimum exposure rate for induction of bud mutation. Such mutation occurred in the particular portion (summer shoot) which grows in the second growing period of the year. These summer shoots originated from the axillary buds in the winter buds in which the apical meristem was injured by radiation. This result indicates the possibility that the mutation occurred in the course of the differentiation of the axillary bud. The effects of the pruning on the induction of the bud mutation in the tea plant by gamma irradiation were tested. The plants were subjected to the radiation of 2.5 KR or 5 KR, and the frequencies of mutations were compared among the plants irradiated before and after pruning, respectively. The frequency of the latter was found to be somewhat higher. A mutant in which arginine content in the new shoot was twice that of the original variety was obtained. There is a close correlation between the arginine content and the taste of the tea. Thus, the change in the composition of the amino acids by irradiation is arousing interest in paving the way for the breeding of high-quality variety. (auth)

29853 RE-TREATMENT OF INDUCED MULBERRY MUTANTS WITH GAMMA-RAYS. Fujita, H. (Inst. of Radiation Breeding, Ibaraki, Japan); Nakajima, K. Gamma Field Symp.; No. 12, 49-61(1973).

From gamma field symposia on induced mutation and chimera in woody plants; Ohmiya-machi, Japan (26 Jul 1973). See CONF-730748–.

From gamma-ray induced mulberry mutants were subjected to gamma rays of 10 kR at the exposure rate of 5 kR/day or 10 kR/day. The irradiated plants were treated with repeated cutting-back of new shoots. Mutation measurements were made on lateral shoots and sub-lateral shoots. Mutation frequencies of mutant strains No. 3198 and IRB 240-1 which derived from cultivar Ichinose were higher than that of the original. Reversion to the original in leaf shape was noticed in both of mutant strains. In mutant strains No. 547 and No. 557 which were induced from cultivar Kokuso No. 21, remarkable increases in both mutation frequencies and mutation spectra were observed. No reversion to the original was detected. Thus, the re-irradiation treatment is considered to be useful for enhancing mutation frequencies and/or mutation spectra. Breeding behavior of IRB 240-1 was tested and several characters were compared between the original and the reverted mutations. (auth)

29854 RADIATION DAMAGE IN WINTER BUDS AND RELATION OF SHOOT CUTTING-BACK TO MUTATION FREQUENCIES AND SPECTRA IN ACUTELY GAMMA-IRRADIATED MULBERRY. Katagiri, K. (Sericultural Experiment Station, Tokyo). Gamma Field Symp.; No. 12, 63-81(1973).

From gamma field symposia on induced mutation and chimera in woody plants; Ohmiya-machi, Japan (26 Jul 1973). See CONF-730748–.

Dormant buds from one-year-old trees were exposed to gamma radiation and planted in the field. These were collected at intervals up to 31 days following irradiation and the amount of radiation damage was observed. Effects cutting back on mutation frequencies and spectra of irradiated plants were studied. Scions of three mutants were grafted on rootstocks and several weeks later were exposed to gamma radiation; three months later mutations were observed. Histological and morphological changes in the mutant plants are described. (HLW)

29855 COMPARATIVE STUDY OF THE REACTION OF SPRING WHEAT MUTANTS TO TREATMENT BY PHYSICAL AND CHEMICAL MUTAGENIC AGENTS. Valodzin, U. G.; Auramenka, B. I.; Gardzei, G. M. (Inst. of Genetics and Cytology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 1, 52-55(1975). (In Belorussian).

Results are presented of a study of the effect of various gamma-ray doses (10 and 5000), intermediate neutron doses (50, 100, and 150 rads), and various concentrations of NEM (0.05, 0.025, and 0.0125%) on the yield of morphological changes in individual, spring-wheat mutants. It is shown that the mutagenic effect depends on the type of radiation and the dose, the concentration of mutagenic agents, and the specificity of the mutants themselves. (SJR)

29856 COMPARISON OF THE DEVELOPMENT RESPONSE OF DIPLOID AND TETRAPLOID PHALARIS FOLLOWING IRRADIATION OF THE DRY SEED. IV. Elimination of Chromosomal Aberrations. Prasad, A. B. (L. S. Coll., Muzaffarpur, India); Godward, M. B. E. Mutat, Res.; 25: No. 3, 311-320(Dec 1974).

The nature of the patterns of elimination of chromosomal aberrations in both root and shoot has been studied in both the species of Phalaris canariensis Linn (2n = 12) and Phalaris minor Retz (2n = 28) after irradiating their dry seeds with filtered and unfiltered x rays. Elimination curves in root and shoot have been studied; the pattern of elimination for each type of aberrations was found to be exponential. (NL)

29857 FURTHER STUDIES WITH VICIA FABA ON THE ENDS OF EXPERIMENTALLY PRODUCED CHROMATID FRAGMENTS. Scheid, W.; Traut, H. (Univ., Munich). Mutat. Res.; 25: No. 3, 321-323(Dec 1974).

When x irradiated chromosomes of Vicia faba were treated with trypsin two types of ends of chromatid fragments, namely open and closed ends, could be observed. To put this qualitative finding on a quantitative basis, the fraction of open ends among the total number of ends classified was determined. When x irradiation was replaced by treatment with an effective chromosome-breaking agent, FUdR (5-fluorodeoxyuridine), again both open and closed chromatid fragment ends were observed and a similar fraction of open ends was found. (NL)

29858 PRODUCTION AND GROWTH OF YOUNG APPLE COMPACT MUTANTS INDUCED BY IONIZING RADIATION. Poll, L. (Royal Veterinary and Agricultural Univ., Copenhagen). Euphytica; 23: No. 3, 521-533(Nov 1974).

The main purpose of this work was to produce compact mutants of apple, i.e., mutants which had shorter internodes and often shorter shoots than is normal for the variety. Scions of the apple varieties Cortland, Ingrid Marie, Grasten, Close, Golden Delicious, and Ildrod Pigeon were treated with gamma radiation. Following two propagations, compact mutants were selected on the basis of internode length; mutants whose internode length was significantly shorter than that of the normal variety. Most of these mutants had shorter shoots and thicker shoot diameters than the normal variety. The correlation between shoot length and internode length has made necessary the introduction of the term "degree of compactness" to characterize the mutants. If the relationship between internode length and shoot length of a mutant is similar to that of the normal variety then it has a low degree of compactness. If, however, the mutant's internode length is considerably less than is normal for the variety (still in relation to shoot length), then the degree of compactness is great. (NL)

29859 COMPARISON OF SOMATIC MUTATION RATES INDUCED IN TRADESCANTIA BY CHEMICAL AND PHYSICAL MUTAGENS. Sparrow, A. H.; Schairer, L. A.; Villabos-Pietrini, R. (Brookhaven National Lab., Upton, NY). Mutat. Res.; 26: No. 4, 265-276(Aug 1974).

From 1st international conference on environmental mutagens; Asilomar, CA (29 Aug 1973).

When genes for flower color and other phenotypic characteristics are present in a heterozygous condition in Tradescantia plants, they can be used as genetic markers for the study of induced mutation. The procedure used is to expose cuttings containing young flower buds to chemical or physical mutagens. One to three weeks later the resultant mutant pink or colorless cells can be seen in mature flowers, and after relatively simple scoring procedures somatic mutation rates can be calculated. Dose-response curves for ethyl methanesulfonate (EMS) and 1,2-dibromoethane (DBE) were obtained and compared with existing x-ray dose-response curves. Two clones, 02 and 4430, were exposed to known levels of EMS in gaseous form for periods from 1 to 19 hours. After exposure to x rays, pink mutation rates showed similar sensitivities for both clones but the rate for colorless was much higher for clone 4430 and the slope much steeper. After treatment with EMS both colorless and pink rates were higher for clone 4430 than for clone 02. Possibly differences in mutation rates between the two clones after EMS treatment may be associated with a larger amount of heterochromatin or a greater number of SAT-chromosomes in clone 4430. (NL)

Radiation Effects on Animals

Refer also to abstracts 32395 and 32396.

Man

Refer also to abstracts 29112, 29203, 29601, 29602, 29806, 29814, 30038, 30360, 30431, 31641, 31642, and 31653.

29860 (FMI-1000-589) CLINICAL DIAGNOSIS AND NATURAL HISTORY OF HODGKIN'S DISEASE AND NON-HODGKIN'S LYMPHOMA IN CHILDHOOD. Stein, R. S.; Ultmann, J. E. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1974. 5p. (CONF-741034-4). Dep. NTIS $4.00.

From 11th international cancer congress; Florence, Italy (20 Oct 1974).

The administration of aggressive radiation and chemotherapy for the treatment of Hodgkin's disease and other lymphomas in children may result in immunosuppression, myelotoxicity, and other specific drug toxicities. Retardation of vertebral body growth following irradiation has been documented, and the danger of asymmetrical deformity following the treatment of lymph node groups which are not clustered about the midline is discussed. (CH)

29861 (ICRP-PUB-21) DATA FOR PROTECTION AGAINST IONIZING RADIATION FROM EXTERNAL SOURCES, SUPPLEMENT TO ICRP PUBLICATION 15. A Report of ICRP Committee 3 adopted by the Commission in April 1971. (International Commission on Radiological Protection, Sutton (UK)). 1973. 101p. INIS.

The appendices contain information for implementing the recommendations of ICRP Publication 15 and therefore relate to the sources of external radiation encountered in medical, dental, and veterinary radiology, and in industry and research. A substantial portion of the Supplement is allocated to data on shielding, but some shielding problems, such as those associated with nuclear reactors and ultra high energy accelerators, are outside its scope. Reference is made to the citation service provided by the Radiation Shielding Information Center at Oak Ridge National Laboratory, and to the European Shielding Information Service at Ispra. Statements by the ICRP on (a) exposure from intra-oral x-ray tubes, and (b) population dose from consumer products, are reproduced. The appendices cover the following matters: collision stopping power of charged particles in water; interpolated values of quality factor; quality factor as a function of charged particle energy; calculation of absorbed dose and dose equivalent distribution in the body; conversion factors for electrons; and for photons; conversion factors and effective quality factors for neutrons; and for protons; neutron sources and shielding; range-energy curves; shielding for beta sources; x-ray and gamma-ray shielding. Also included are a list of references and general shielding bibliography. (INIS)

29862 (NP-20320) GENERAL RULES FOR RADIOLOGICAL WORK. (Bergen Univ. (Norway)). [nd]. 38p. (In Norwegian). Dep. NTIS (US Sales Only) $5.00.

These rules and guidelines are intended to give an elementary introduction to those precautions which must be taken and to the regulations applicable in all radiological work. A brief review is given of Norwegian laws applicable in the field of radiology and the most important radiological terms are explained. The ICRP recommendations are summarized and explained and the biological effects of radiation briefly discussed. The general principles of shielding are presented and the general rules for use of radioactive materials and other radiation sources are given. Comments on these rules and instructions for disposal of radioactive waste at the University conclude the guidelines. A number of tables giving useful data are included. (NO)

29863 (NP-20349) NUCLEAR POWER PLANT BY THE OSLOFJORD. Introductory Radioecological Studies. Garder, K.; Loeken, P. C. (Eds.). (Norges Vassdrags- og Elektrisitetsvesen, Oslo. Direktoratet for Statskraftverkene). Jan 1974. 186p. (In Norwegian). Dep. NTIS (US Sales Only) $12.50.

Radiation doses to individuals resulting from release of radioactive materials to the atmosphere and to the cooling water from a nuclear power plant in the Oslofjord district were calculated. Both internal doses resulting from consumption of food stuffs contaminated by releases to the atmosphere and to the cooling water recipient and external doses from releases to the cooling water are considered. Nominal collective doses to the thyroids of children from ^{131}I in milk are also presented. The results are presented in a number of tables, maps, and figures. (NO)

29864 CALCIFICATION IN PELVIC LYMPH NODES CONTAINING HODGKIN'S DISEASE FOLLOWING RADIOTHERAPY. McLennan, T. W.; Castellino, R. A. (Stanford Univ., Palo Alto, CA). Radiology; 115: No. 1, 87-89(Apr 1975).

The appearance of roentgenographically demonstrable calcification in intrathoracic lymph nodes containing Hodgkin's disease following radiotherapy is an unusual but recognized occurrence. Two patients with Hodgkin's disease in whom similar lymph node calcifications developed in involved pelvic nodes following radiotherapy are described. Such calcification appears to be secondary to tumor degeneration which may result from a variety of postulated causes, including radiotherapy. (auth)

29865 ERYTHROLEUKEMIA FOLLOWING TOTAL-BODY IRRADIATION FOR ADVANCED LYMPHOCYTIC LYMPHOMA. Rappaport, A. H.; Cohen, R. J.; Castro, J. R. (Univ. of California, San Francisco). Radiology; 115: No. 1, 179-180(Apr 1975).

A patient with advanced lymphocytic lymphoma received treatment with total-body irradiation. Two years later acute erythroleukemia developed which proved fatal. Previous experience with total-body irradiation is considered and the relationship between radiation exposure and leukemia discussed. (auth)

29866 RADIATION THERAPY IN MULTIPLE MYELOMA. Mill, W. B. (Washington Univ., St. Louis). Radiology; 115: No. 1, 175-178(Apr 1975).

In this retrospective study of 76 patients with myeloma, the indications for radiation therapy are reviewed and its value analyzed. Eleven patients presented have a "solitary plasmacytoma" and 65 patients presented have disseminated disease. Radiation therapy is successful in both the palliation of pain (81% of cases) and in producing long-term remission and possibly cure in solitary lesions. (auth)

29867 FEVER, LETHARGY, AND RASH COMPLICATING TREATMENT FOR WILMS' TUMOR: A NEW SYNDROME. Cassady, J. R.; Meyer, G.; Jaffe, N.; Filler, R. M. (Children's Hospital, Boston). Radiology; 115: No. 1, 171-174(Apr 1975).

A syndrome of fever, lethargy, irritability and rash occurred in patients undergoing surgery, irradiation and chemotherapy for Wilms' tumor. The incidence, course and severity of these findings are described. Potential etiologic factors are analyzed and a hypothesis advanced. (auth)

29868 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. I. Introduction. Reinhold, H. S. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). Curr. Top. Radiat. Res.; 10: No. 1, 3-8(Jun 1974).

With the use of megavolt radiation in radiotherapy, the dose received by the underlying tissues instead of by the skin has become the limiting factor in the irradiation scheme. The effects are manifested as morphological changes in the blood vessels and the parenchyma as well as in functional disorders of irradiated organs, including disturbances in their vascular supply. Therefore evaluation of radiation damage to the blood vessels, separately from damage to parenchymal cells, and of the response of the general circulation to local radiation injury is of importance. The early, intermediate, and late irradiation effects are studied separately. (NL)

29869 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. III. Ultrastructure of the Vessel Wall. Maisin, J. R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Curr. Top. Radiat. Res.; 10: No. 1, 29-57(Jun 1974).

The early, intermediate, and late radiation effects upon the different layers of the capillaries in various organs are reviewed. Emphasis is placed on the results obtained with the aid of the electron microscope. (NL)

29870 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. IV. Structure Changes in Blood Vessels. Reinhold, H. S. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). Curr. Top. Radiat. Res.; 10: No. 1, 58-74(Jun 1974).

Radiation-induced changes in the structure of the blood vessel system as can be demonstrated with various techniques such as microcirculation studies, histopathology and arteriography are reviewed. Early changes consist mainly of an inflammatory type of reaction with dilatation of the capillaries. The morphological picture of late radiation damage to blood vessels is characterized by degenerative changes in the arteries, arterioles and capillaries, while tissues such as lung may show fibrotic changes. The changes in the arteries resemble those occurring in arteriosclerosis and hypertension. (NL)

29871 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. V. Noncellular Factors. Jovanovic, D. (Univ., Louvain, Belgium). Curr. Top. Radiat. Res.; 10: No. 1, 75-84(Jun 1974).

Radiation damage of macromolecular, noncellular structures can contribute to changes in blood vessels and microcirculation. Investigations on the radiation-induced depolymerization of mucopolysaccharide matrices are reviewed. Fast neutrons have a RBE of only 0.6 for this effect. The influence of various radioprotective substances is mentioned. (NL)

29872 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. VI. Lymphatics. Jovanovic, D. (Univ., Louvain, Belgium). Curr. Top. Radiat. Res.; 10: No. 1, 85-97 (Jun 1974).

Investigations on the effect of radiation on the functional and morphological integrity of the lymphatic system are reviewed. Emphasis is laid on the influence of irradiation on lymphatic dynamics and on the barrier function of lymph nodes. Lymphatic dynamics are most frequently assessed by the estimation of the patency of lymphatic vessels; the barrier function of lymph nodes is usually investigated by perfusing the node with a suspension of cells and particles. Progression of the lymph through irradiated lymphatics was normal in most of the cases. Deviation of the lymph flow was frequently found to be due to extravascular fibrosis. Spread of cellular material above the irradiated lymph node following intralymphatic or intranodal injection of normal or neoplastic cells was facilitated by previous irradiation. (NL)

29873 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. VII. Functional Response of Heart and Major Vessels. Keyeux, A. (Univ., Louvain, Belgium). Curr. Top. Radiat. Res.; 10: No. 1, 98-108(Jun 1974).

The response of the cardiovascular system to irradiation directly or indirectly influences the activity of organs and tissues by depriving them of an adequate blood supply. Information was collected on the functional disturbances in the heart and the major vessels, induced by whole-body and regional irradiation. The effects of ionizing radiation on the electrical activity of the heart, the cardiac output, the arterial and venous blood pressure and on the vascular resistance are reviewed. (NL)

29874 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. VIII. Blood Flow and Permeability in Liver, Kidney, and Lung. Dunjic, A. (Univ., Louvain, Belgium). Curr. Top. Radiat. Res.; 10: No. 1, 109-134(Jun 1974).

Experiments undertaken in order to study acute and late radiation effects in liver, kidney, and lung respectively, are reviewed. For all three organs, the methods that give the most valuable information are based on measurements with radioactive compounds. (NL)

29875 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. IX. Blood Flow and Permeability in the Central Nervous System. Keyeux, A. (Univ., Louvain, Belgium). Curr. Top. Radiat. Res.; 10: No. 1, 135-150(Jun 1974).

Functional changes in the central nervous system tissue can be elicited with very low doses of ionizing radiation. The changes can be studied by means of electrophysiological techniques. Radiation probably acts on the central nervous system by means of radiation-induced changes in both blood supply to the brain and nutritional exchanges through the blood-brain barrier. Contrary to the acute vascular damage and early functional impartment which have been studied frequently, the physiopathological pathways of the delayed radiation effects in the central nervous system and their relevance to vascular damage are still poorly investigated and understood. (NL)

29876 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. X. Blood Flow and Permeability in Irradiated Skin. Dunjic, A. (Univ., Louvain, Belgium). Curr. Top. Radiat. Res.; 10: No. 1, 151-169(Jun 1974).

Experiments on the vascular changes in the skin as a function of post-irradiation time are reviewed. The best estimates of quantitative vascular changes, induced by local irradiation of the skin, are based on tracer techniques in which either a labelled protein is injected into the circulation or a more or less diffusible substance is deposited locally. In addition to the quantitative evaluation of permeability, blood volume and effective blood flow changes during the early, acute and chronic phases of radiation skin injury, the mediators as well as some modifying agents and factors of the early inflammatory reaction are considered. (NL)

29877 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. XII. Discussions and Conclusions. Reinhold, H. S. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands); Keyeux, A.; Dunjic, A.; Jovanovic, D.; Maisin, J. R. Curr. Top. Radiat. Res.; 10: No. 1, 185-198(Jun 1974).

In general radiation injuries following radiotherapeutic treatment can be considered as delayed radiation effects. Changes in the structure of blood vessels are still taking place months after the irradiation. Innervation of blood vessels as a post-irradiation phenomenon has also been reported. As a late effect of radiation, blood flow is diminished in skin, kidneys and liver, whereas it is enhanced in the brain. It is likely that a threshold dose exists for late effects such as vascular damage. Diabetes and syphilis predispose to radiation damage; studies on the influence of hypertension on radiation damage give unequivocal results. Better understanding of radiation induced vascular damage may lead to better application of radiotherapy in the treatment of cancer. (NL)

29878 RADIATION PROTECTION IN EQUINE RADIOGRAPHY. Wood, A. K. W. (Univ. of Melbourne); Robotham, F. P. J.; Reynolds, K. M.; Leith, I. S.; Burns, P. A. Aust. Vet. J.; 50: No. 9, 373-379(Sep 1974).

During radiography of the carpus of horses, calcium fluoride thermoluminescent dosemeters were used to measure the radiation exposure to the hand of an assistant positioning the x-ray film. Three portable x-ray machines and a mobile machine were used during the recordings. The effects of x-ray machine, radio-

graphic technique, and lead rubber gloves upon radiation exposure to the hand were investigated. The size of the primary beam of the x-ray machine was found to be the major factor in determining the dose of radiation received by the hand. The highest radiation exposures were recorded when using two portable machines which were fitted with beam limiting devices that permitted only one primary beam size. The lowest exposures were measured when radiographs were taken with the mobile machine that was fitted with a light beam diaphragm. The control of primary beam size with a light beam diaphragm was found to be the most effective method of reducing radiation dosage to the hand. It is strongly recommended that for equine radiography a light beam diaphragm be fitted to and used on all x-ray machines, and a cassette holder be used to keep the hands out of the primary beam. (auth)

29879 CLINICAL AND RADIOBIOLOGICAL ASPECTS OF THE HIGH LET RADIATIONS IN VIEW OF THEIR MEDICAL APPLICATION. Dragoni, G. (Univ. of Milan). Radiaz. Alta Energ.; 13: No. 2, 51-67(Apr 1974). (In Italian).

A descriptive discussion is presented of clinical and radiobiological aspects of high LET radiation. The therapeutic uses of heavy particles, particularly protons, neutrons, and mesons, are reviewed and their RBE is compared with that of traditional radiotherapy. (JSR)

29880 CONDITIONS FOR THE TRANSFER TO MAN OF EXPERIMENTAL RESULTS ON ANIMALS FOR CHEMICAL RADIOPROTECTION AGENTS. Santha, A. Honvedorvos; 26: No. 3, 183-191(1974). (In Hungarian).

The basic criterion for the efficiency of chemical radioprotective agents is the reduction of radioinduced mortality in mammals. Comparison of the efficiency of individual chemicals is made by establishing differences in the survival rates, length of survival, and body weight of animals treated with different radioprotective agents in equimolar doses and then irradiated and of animals receiving no chemotherapy but irradiated under the same conditions as the test animals. Prevention of acute radiation sickness is the first property sought in protective agents. Before using radioprotective agents for human beings animal research on the pharmacology, toxicology, and tetralogy is necessary. From the results of these animal experiments proposals are derived for human research. Therefore clinical requirements must be met in animal research. Reactivity differences between human and animal organisms must be reduced as much as possible by taking into consideration phylogenetic and external factors causing different responses to radiation in humans and animals. The conditions for establishing human tolerances are discussed. (tr-auth)

29881 RADIATION BONE INJURY. Mitrov, G.; Angelova, I.; Harbov, I.; Todorov, I. Rentgenol. Radiol.; 13: No. 2, 73-79 (1974).

During the past 13 years three patients with radiation necrosis of the neck of the femur have been observed (among 710 patients with malignant tumors of the uterus, 0.42%), one patient with radionecrosis of the humerus and one with radiation injury to the clavicle and ribs (among 882 patients with breast cancer). The three cases of radiation necrosis of collum femoris were among 415 patients irradiated with apparatus GUT-400 with standard dimensions of cutaneous fields 10 : 15 cm. In the other group of 295 patients irradiated with "Rokus" apparatus with dimensions of cutaneous fields, individually determined in accordance with pelvic size, bone radiation necroses were not observed. In two cases the radiation injury was unilateral although on either side equal dose has been applied. It may therefore be suggested that in addition to dose other factors—physical and biological—are somehow responsible for the occurrence of bone necrosis. Radiation necroses have developed after cobalto-therapy when the dose applied has exceeded 5000 roentgen. The interval between the end of radiation treatment and the appearance of bone lesions varies within broad limits. (Abstr. Bulg. Sci. Med. Lit.)

29882 REVIEW OF THE CURRENT STATE OF RADIATION PROTECTION PHILOSOPHY. NCRP Report No. 43. Washington, DC; National Council on Radiation Protection and Measurements (1975). 55p.

The current NCRP position and plans regarding radiation protection standards are discussed. A critique is given of recent reports of the UN Scientific Committee on the Effects of Atomic Radiation and the National Academy of Sciences Advisory Committee on the Biological Effects of Ionizing Radiations. A historical review is given of recommended dose limits for the population and aspects of risk estimation in relation to dose limits. Current NCRP dose limits and current ICRP dose limits are tabulated. (HLW)

29883 RISK ANALYSIS OF NUCLEAR WASTE MANAGEMENT SYSTEMS. Smith, T. H.; Winegardner, W. K. (Battelle Pacific Northwest Labs., Richland, WA). Power Eng.; 79: No. 2, 35-37(Feb 1975).

The safety of nuclear waste management systems is being addressed by the quantitative risk analysis study conducted by Battelle Pacific Northwest Laboratories. The results will help guide research and development efforts, and will be used in the formulation of waste product criteria and for comparisons of alternative waste management procedures. Evaluating proposed waste management systems is a complicated process. It includes assessments of technical feasibility, R&D needs, costs, environmental impacts, and both the calculated and the publicly perceived safety. The method selected for safety assessment of proposed year-2000 waste management systems is quantitative risk analysis. It considers both the consequences of postulated releases of radioactive material and the estimated probabilities of such events. This is a departure from the traditional "maximum credible accident" approach which deals only with the consequences of maximum-release accidents. (HLW)

29884 PRESENT STATUS OF THE TIME FACTOR IN CLINICAL RADIOTHERAPY. Part II. The Nominal Standard Dose Formula. Fletcher, G. H.; Barkley, H. T. Jr.; Shukovsky, L J. (Anderson (M. D.) Hospital and Tumor Inst., Houston, Tex. (USA)). J. Radiol., Electrol., Med. Nucl.; 55: No. 11, 745-751(Nov 1974).

Clinical observations are not compatible with the assumption that acute skin reaction recovery can be equated with connective tissue damage recovery. The influence of the over-all treatment time in treatment schedules of more than 3 weeks is not adequately expressed in the NSD formula. The damage to connective tissue increased with higher doses per fraction. To minimize late fibrosis, schedules using as many fractions as practical should be preferred when permanent cure is the goal of the treatment. An absolute concept of tolerance must be replaced by a flexible concept that takes into consideration the control rate versus the incidence and severity of complications as well as functional results. Time-dose-fractionation schemes directed at increasing the effectiveness of irradiation on tumors should be designed. (FR)

29885 AUTOMATISATION OF RADIOTHERAPY: AUTOMATION OF TREATMENT APPARATUS. Chavaudra, J.; Bernard, D.; Houlard, J. P.; Eschwege, F.; Dutreix, J. (Institut Gustave Roussy, 94 - Villejuif (France). Dept. des Radiations). J. Radiol., Electrol., Med. Nucl.; 55: No. 11, 769-774(Nov 1974). (In French).

It seems that one of the main reasons for automation of radiotherapy apparatus is the reduction in the number and degree of errors that may be committed during treatment. The main problem is, of course, the position of the patient in relation to the apparatus, especially in relation to the treatment table. The solutions presented here may be classified into three main groups: passive recording of the geometrical parameters of irradiation permitting an "a posteriori" study of the inaccuracies occurring during treatment; Automatic control of the conditions of irradiation, which is then stopped when in disagreement with the prescription; and automatic mobilization of the treatment apparatus. The most reasonable solution seems to be the second, both owing to its objectives and its cost. This solution leads to an increase in the cost price of the apparatus of 20 to 50% depending on the type of apparatus. It requires sufficient quality of the apparatus and its environment. The system presented here also uses a small computer and automatic simulators. (FR)

29886 USE OF A SEMI-CONDUCTOR FOR THE CONTROL OF RECTAL AND VESICAL DOSES IN IRRADIATIONS OF THE VAGINA AND UTERUS WITH CESIUM-137 AND RADIUM SOURCES. Marcuse, H. R.; Burgers, J. M. V. (Wilhelmina Gasthuis; Hopital Antoni van Leeuwenhoekhuis (Netherlands)). J. Radiol., Electrol., Med. Nucl.; 55: No. 11, 765-767(Nov 1974). (In French).

A diode for the measurement of rectal and vesical doses is presented. This is a cylinder 5 mm long, of diameter 5 mm. The crystal is connected to a cable. The diode is placed within a thin stainless steel capsule on which are marked the calibration measurements to show the depth of the detector within the body of the patient. The currents induced by the dose to which the crystal is exposed may be read on the digital voltmeter after passage through an amplifier. The amplifier and the voltmeter are supplied by nickel cadmium batteries which are connected to the mains. When the measurements are carried out on the patient, the mains are disconnected. Thanks to this precaution, the patient does not risk electrocution. The indication of dose rate is linear up to about 800 rads per hour, the indication given by the detector is proportional to the dose rate. Linearity of the indication of the dose is in relation to the energy of the source. The readings are obtained instantaneously. (FR)

29887 TELECOBALT AT LOW DOSE RATE. Second Report. Pierquin, B.; Baillet, F.; Brown, C. (Hospital Henri-Mondor, 94 - Creteil (France)). J. Radiol., Electrol., Med. Nucl.; 55: No. 11, 757-763(Nov 1974). (In French).

The following general conclusions may be based on the results in the thirty-seven cases observed. The initial effect on the neoplasm (T or N) is in the majority of cases dramatic. Most of the lesions treated up to the present time have been very extensive lesions, which would have been incurable by most classical techniques; a therapeutic effect superior to that obtained by fractionated radiotherapy at high dose rate was obtained. The early effect on normal tissues is scarcely apparent before 3,000 rad have been given. It develops rapidly between 3,000 and 7,000 rad especially the mucosa; the skin reaction remains quite mild. Medium term (between 1 and 4 years), recurrences are seldom found and necroses are limited to the tissues initially invaded by the tumor, with very few exceptions. If the total dose of 7,000 rad is split into two periods separated by four weeks (split course therapy), it seems as though one can greatly moderate the normal tissue reaction, including necrosis rate, without increasing the frequency of recurrence. (FR)

29888 A NEW METHOD FOR SOURCE SPECIFICATION IN CURIETHERAPY. Dutreix, A. (Institut Gustave Roussy, 94 - Villejuif (France)). J. Radiol., Electrol., Med. Nucl.; 55: No. 11, 781-784(Nov 1974). (In French).

A working party made up of radiotherapists, radiation physicists, and representatives of the C. E. A. (Saclay) suggest a new method of specification for radioactive sources used in curietherapy. The notion of apparent or equivalent activity is replaced by nominal exposure rate (the exposure rate at a reference distance from a radioactive source it is expressed in milliroentgens per hour at one metre). This new definition prevents confusion in the meaning of activity and allows the curietherapist to avoid errors introduced when doses are determined by assuming a different specific gamma constant from that used when the original calibrations or computer calculations were made. (FR)

29889 KINETIC STUDY ON THE ESTABLISHMENT OF TUMOR REOXYGENATION BY IRRADIATION. Okumura, Y.; Matsuzawa, T. (Aichi Cancer Center, Nagoya (Japan). Dept. of Experimental Radiology). Strahlentherapie; 148: No. 4, 375-380(Oct 1974).

A kinetic model for the establishment of tumor reoxygenation by irradiation was presented. The time at the maximum reoxygenation after irradiation and the fraction of reoxygenated cells, which were previously hypoxic, were calculated. It was found that a dose higher than the minimum dose which depended on the radiosensitivity of tumors was needed for the establishment of the reoxygenation. A higher dose than 200 rad daily and longer intervals were recommended in the treatment of radioresistant tumors. (auth)

29890 THE RADIATION EXPOSURE DUE TO INVESTIGATIONS CARRIED OUT BY A THERAPY SIMULATOR. The Radiation Exposure of the Foetus and the Mother of Roentgenological Measures Taken in Preparation of Intrauterine Transfusion (Phantom Measurements). 1. Communication. Saebel, M.; Schmidt, T.; Weishaar, J. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Strahlenabteilung; Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Inst. fuer Physikalische und Medizinische Strahlenkunde). Strahlentherapie; 148: No. 4, 350-358(Oct 1974). (In German).

The precise location of the foetus must be known in preparing for intrauterine transfusion. The necessary x ray examination of the pregnant woman affects both the mother and the foetus. A procedure similar to that employed in calculating the focal dose in radiotherapy can be used in assessing this effect on the organs. It is, above all, the tissue-air ratios for the types of rays used in x-ray diagnosis which are needed for the purpose. In the present study, the tissue-air ratios for generation voltages of 60 kV, 80 kV, and 100 kV and for field sizes of 100 cm^2, 200 cm^2, and 400 cm^2, were ascertained ionometrically in a plexiglass phantom, using a therapy simulator from Siemens AG. The dosage output in the active x-ray beam, the half-value thickness, and the degree of homogeneity of the radiation used, were also determined. A practical example is given to show how these data can be used to ascertain the radiation exposure of the organs of preparatory x-ray examination for intrauterine transfusion. It appears that an effect of between 1 and 5 R on the whole foetus, and an effect of between 5 and 25 R on the sections of the maternal bone marrow concerned must be reckoned with. The data can further be used to assess the radiation exposures of the organs of other x-ray examinations. (auth)

29891 POST-IRRADIATION CHANGES IN THE PULMONARY FUNCTION IN BREAST CANCER. Rakovec, P.; Plesnicar, S.; Janezic, A. (Ljubljana Univ. (Yugoslavia). Interna Klinika; Ljubljana Univ. (Yugoslavia). Onkoloski Inst.). Strahlentherapie; 148: No. 4, 339-346(Oct 1974). (In German).

Twenty-two patients irradiated pre- and postoperatively for breast cancer were subjected before and after irradiation to a series of tests for pulmonary functions. Some of the patients were examined as late as four months after preoperative irradiation. The purpose of the study was to assess the functional changes in lung tissue brought about by irradiation. Neither clinically nor roentgenologically significant effects of radiotherapy could be observed. The results of functional tests, however, bear out the hitherto existing findings that after irradiation vital capacity, residual volume, and diffusion capacity are significantly lowered. An uneven distribution of ventilation and perfusion could not be demonstrated. The lowering of the oxygen pressure in the arterial blood was not significant. Contrary to observations so far published, no decrease in the dynamic pulmonary volumes was observed. An inquiry was made into the so-far unsolved question of intrapulmonary right-to-left shunts and of the two components of the diffusion capacity. After irradiation, the intrapulmonary right-to-left shunts had considerably increased and kept doing so until the last examination done four months after irradiation. The lowered diffusion capacity is due to both the membrane diffusion capacity and the blood volume in the pulmonary capillaries. In the beginning, the decrease in the membrane diffusion capacity was more pronounced, whereas in the post-irradiation phase, the decrease in the blood volume in the pulmonary capillaries was more significant. (auth)

29892 TREATMENT OF INOPERABLE CHONDROSARCOMAS BY RADIOACTIVE SULPHUR. Kolarz, G.; Bergmann, H.; Hoefer, R. (Vienna Univ. (Austria). 2. Medizinische Klinik); Kotz, R.; (Vienna Univ. (Austria). Orthopaedische Klinik); Salzer, M. (Vienna Univ. (Austria). Pathologisch-Anatomisches Inst.). Z. Orthop. Ihre Grenzgeb.; 112: No. 3, 412-419(Jun 1974). (In German).

Radioisotope therapy with sulphur-35 was performed in a patient with incurable chondrosarcoma. A total of 1,500 mCi of ^{35}S, given in five single doses, was applied intravenously. The interval between the treatments was at least four weeks. Side effects on hemopoesis were originally small; irreversible disturbance of bone marrow was observed just after the last treatment. Temporary clinical success during the treatment, but no diminution of tumor size was observed. Because of the superficial position of the tumor it was possible to record continuously sulphur uptake in chondrosarcoma. The justification of sulphur-35 treatment of a patient with incurable chondrosarcoma is discussed in comparison to the literature. (auth)

29893 PRACTICAL IRRADIATION PLANNING WITH A DEDICATED SYSTEM. Tiemann, J. (Mueller (C. H. F.) G. m. b. H., Hamburg (F. R. Germany). Abt. fuer Medizinische Datenverarbeitung). Strahlentherapie; 148: No. 5, 463-467(Nov 1974). (In German).

A dedicated system for irradiation planning is described, including the functional environment of a radiotherapeutic department. Besides a description of the fundamental construction and function of the system, in particular the ergonomic aspect and special possibilities of visual and mathematical optimization are represented. First experiences and integration into a realized system of hospital information are briefly explained. (auth)

29894 DOSE DISTRIBUTION MEASUREMENTS IN ELECTRON LENS THERAPY WITH A 45 MeV BETATRON. Hietanan, A.; Kiviniitty, K.; Taskinen, P. J.; Vogt, H. (Oulu Univ. (Finland). Dept. of Radiotherapy). Strahlentherapie; 148: No. 6, 556-559 (Dec 1974).

Dose distribution for electron lens therapy were measured in the Oslo phantom under different conditions. Its clinical use is discussed and conclusions are drawn concerning electron lens therapy. (auth)

29895 DOSIMETRY AND IRRADIATION METHODS IN ELECTRON THERAPY. Rassow, J. (Essen Univ. (Gesamthochschule) (F. R. Germany). Abt. fuer Klinische Strahlenphysik). Strahlentherapie; 148: No. 5, 475-496(Nov 1974). (In German).

From symposium on trends of modern radiotherapy; Vienna, Austria (4 May 1974). 21 figs.; 5 tabs.; 9 refs.

A survey is given of the methods and possibilities which are developed for the planning and carrying out of electron therapy in recent years. The dosimetry essentially differs from that of high-energy photons, i.e., it requires determination of the medium energy at the actual measuring place, with the purpose of recording the conversion factors dependent on the area, in order to be able to convert the ion to the energy dose. The peculiarities that appear in electron dosimetry by the use of films and thermoluminescence dosimeters are discussed. Irradiation methods and the dose distribution gained are explained by the example of irradiations on standing and contralateral fields and of centric and telecentric

pendulum irradiations. An approximative consideration of oblique body contours in standing fields and telecentric pendular technique as well as inhomogeneities, especially in higher electron energies and motion techniques, is described. (auth)

29896 PHYSICAL AND DOSIMETRIC BASES OF THE THERAPY WITH DENSELY IONIZING PARTICLES AND FAST NEUTRONS. Lorenz, W. J.; Hoever, K. H. (Deutsches Krebsforschungszentrum, Heidelberg (F. R. Germany). Inst. fuer Nuklearmedizin). Strahlentherapie; 148: No. 5, 497-501(Nov 1974). (In German).

From symposium on trends of modern radiotherapy; Vienna, Austria (4 May 1974). 3 figs.; 4 refs.

The physical qualities of protons, α particles, heavy ions, fast neutrons, and π mesons are described. Owing to their high ionization density, α particles and neutrons are well suited for the therapy of tumors with great hypoxic portions. High-energy protons are loosely ionizing particles, their advantage lies in the good distribution of the depth dose. For radiotherapy, π-mesons seem to be most suitable as they not only possess a good depth dose distribution but also show a very high ionization density and a great biological efficacy only in their target volume due to their interactions with matter; tissue, on the other hand, is largely preserved. (GE)

29897 ALTERATION OF PHA STIMULATION AND OF CYTOCHEMICAL BEHAVIOUR OF LYMPHOCYTES FROM PATIENTS WITH HODGKIN'S DISEASE AND BRONCHOGENIC CARCINOMA INDUCED BY ^{60}Co RADIOTHERAPY. Kruesmann, W. F.; Slanina, J.; Hennekeuser, H. H.; Wahren, C.; Scholz, R.; Vorwerck, H. (Freiburg Univ. (F. R. Germany). Medizinische Klinik; Freiburg Univ. (F. R. Germany). Abt. fuer Strahlentherapie). Z. Krebsforsch. Klin. Onkol.; 81: No. 2, 119-134 (1974). (In German).

8 figs.; 3 tabs.; with refs. Parts of a thesis by Wahren, C. and Scholz, R.

Phytohemagglutinin stimulation and cytochemical behavior of lymphocytes from patients with Hodgkin's Disease and PHA stimulation of lymphocytes from patients with bronchogenic carcinoma were studied before and during the course of ^{60}Co radiotherapy. Phytohemagglutinin stimulation of lymphocytes was significantly diminished in patients with bronchogenic carcinoma during radiotherapy and in patients with Hodgkin's Disease receiving supradiaphragmal irradiation. Lymphocyte cultures, not stimulated, showed no alteration of ^{3}H-thymidine uptake during the course of radiotherapy. Cytochemical examination of lymphocytes from patients with Hodgkin's Disease showed an increase in PAS content and an increase in beta glucuronidase activity caused by an increase in beta-glucuronidase-B-lymphocytes. The DNA content of lymphocytes when measured photometrically after Feulgen staining showed no alteration during the course of radiotherapy. (auth)

29898 MEASUREMENTS CONCERNING ELECTRON SINGLE-FIELD IRRADIATION OF THE RETROBULBAR SPACE OF THE EYE. Sommer, F.; Schmidt-Hermes, H. J.; Hoegel, A. (Universitaet des Saarlandes, Homburg/Saar (F. R. Germany). Radiologische Klinik). Strahlentherapie; 148: No. 5, 527-530 (Nov 1974). (In German).

Examinations were carried out by means of betatron phantom measurements, in order to find out whether it is possible to develop a useful method of irradiation of the eye region that guarantees the greatest possible protection of the lens. Measurements made under the conditions described made evident that the best possible radiation protection of the lens in single-field irradiation is achieved when using an electron radiation of 18 MeV as well as an absorption device consisting of Perspex (Plexiglas). (auth)

29899 POSSIBILITIES AND CHANCES OF RADIOTHERAPY WITH DENSELY IONIZING PARTICLES AND NEUTRONS. Scheer, K. E. (Deutsches Krebsforschungszentrum, Heidelberg (F. R. Germany). Inst. fuer Nuklearmedizin). Strahlentherapie; 148: No. 5, 440-446(Nov 1974). (In German).

From symposium on trends of modern radiotherapy; Vienna, Austria (4 May 1974). 6 figs.; 10 refs.

Beams of the type that show a significant increase of the dose or a high LET at the end of their course, in contrast to Megavolt x-rays or gamma rays, promise certain advantages in the treatment of tumors. Fast neutrons have a high LET, but do not show an increase of the depth dose. Protons and α particles show a significant increase of the depth dose, but a low LET. π-mesons show a high LET as well as an increase of the depth dose. (auth)

29900 IRRADIATION PLANNING BY COMPUTERS. Benedetti, G. R. (Siemens A. G., Erlangen (F. R. Germany). Unternehmensbereich Medizinische Technik). Strahlentherapie; 148: No. 5, 468-474(Nov 1974). (In German).

From symposium on trends of modern radiotherapy; Vienna, Austria (4 May 1974). 8 figs.

The Sidos-U-System differs from the small dedicated system, in order to meet all requirements of a therapeutic department, while making the best use of the available space. The Sidos-U-System can be modularly extended from a motoric slide rule to a powerful computer of medium size; moreover, by means of a transmission module, it can be connected to a great computer. (auth)

29901 MAN AND NUCLEAR ENERGY: SOME ASPECTS OF PROTECTION STUDIES. Bittel, R.; Coulon, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Cah. Ing. Agron.; No. 288, 7-13(Aug 1974). (In French).

The concept of dose limit, a basis of radiation protection studies, and its significance are first considered, and the restraints and controls implied within and outside installations are summarized. In France various Ministry Departments are associated in the application of national regulations on nuclear energy, chiefly the Ministries of Industry and Health through specialized services, the Central Service for the Safety of Nuclear Installations (SCSIN) and the Central Service for Protection against Ionizing Radiation (SCPRI). Investigations on radionuclide transfers from the site of release to the critical organ in man are carried out by the Protection Division of the CEA. Previsional models incorporating experimental data are developed in order to evaluate, for every circumstance, the long-term consequences of very low level radioactive releases into the environment, which is becoming more and more interesting at a time when there is a trend toward using nuclear solutions to solve the energy problem. (FR)

29902 EARLY EXPERIENCE WITH THE SL 25 PREPARATION IN THE TREATMENT OF RADIATION-INDUCED DRYNESS OF THE MOUTH. Breunsbach, J.; Dvorak, K. (Staedtisches Krankenhaus Koeln-Merheim (F. R. Germany). Roentgeninstitut und Strahlenklinik). Strahlentherapie; 148: No. 3, 298-302(Sep 1974). (In German).

2 tabs.; 11 refs.

A report is given on early experience with SL 25 (trithioparamethoxyphenylpropene), a salivant preparation, in the therapy of radiation-induced dryness of the mouth. Clinical improvement was obtained in 13 (87%), and therapy failed in 2 (13%) of 15 patients treated. The effect set in after an average of 7 days of treatment. Scintigrams of the salivary glands done in four of the patients in the course of treatment were found to agree with the clinical results. It is recommended that therapy be attempted also in patients treated with large focal doses because. 1) the response to radiation stress on the salivary glands varies widely and is unpredictable; 2) the focal dosage given in relation to the seat of the tumor is not fully conclusive of the actual stress exerted on the salivary glands. (auth)

29903 OPTIMUM DOSE PER FRACTION IN RADIOTHERAPY ESTIMATED FROM SURVIVAL CURVES. Okumura, Y.; Uchiyama, Y.; Morita, K. (Aichi Cancer Center, Nagoya (Japan). Dept. of Experimental Radiology; Aichi Cancer Center, Nagoya (Japan). Dept. of Radiation Therapy). Strahlentherapie; 148: No. 3, 288-294(Sep 1974).

8 figs.; 16 refs.

The optimum dose per fraction in radiotherapy was evaluated and estimated by the analysis of survival curves, considering the biological error, the existence of hypoxic cells, and radiosensitizing effects by drugs. The optimum doses were 200, 300 to 500, and 800 rad for high, moderate and low radiosensitivity of tumors, respectively. (auth)

29904 INTRAARTICULAR RADIOACTIVE COLLOIDAL GOLD IN THE TREATMENT OF DIFFUSE VILLO-NODULAR SYNOVITIS OF THE KNEE. Koptan, M. T.; El-Zorkany, K. (Cairo Univ. (Egypt). Orthopaedic Section); El-Bolkainy, N. (Cairo Univ. (Egypt). Div. of Nuclear Medicine). Strahlentherapie; 148: No. 3, 295-297(Sep 1974).

3 figs.; 4 refs.

Intraarticular radioactive colloidal gold (^{198}Au) was used in the treatment of two patients with diffuse villonodular synovitis of the knee joint. The dose of the radiogold injected was one millicurie. Scanning of the knee illustrated the outline of the synovial cavity. The intraarticularly injected radioactive gold was gradually absorbed to the regional lymph nodes. Open synovial biopsy three months later revealed evidence of healing. (auth)

29905 VARIATION OF RBE AS A FUNCTION OF DEPTH IN A HIGH-ENERGY ELECTRON BEAM IN THE FIRST MILLIMETERS OF THE IRRADIATED TISSUES DETERMINED BY THE

OBSERVATION OF SKIN REACTIONS ON PATIENTS (A CLINICAL TRIAL). Wambersie, A.; Zreik, H.; Prignot, M.; van Dorpe, J. C. (Louvain Univ. (Belgium). Centre des Tumeurs). Strahlentherapie; 148: No. 3, 279-287(Sep 1974).

3 figs.; 3 tabs.; 20 refs.

A possible variation of RBE as a function of depth in the first millimeters of the irradiated medium in an electron beam was investigated using skin reactions on patients as a biological criterion. The variation of RBE between surface and 10 mm depth was assessed by covering half of the irradiated fields by 10 mm Perspex and then comparing the skin reactions with or without this Perspex slab. The measured dose build-up was small (< 5%) in these treatment conditions. A total number of 106 fields was observed during and after fractionated irradiation: 80% did not show a clear difference in skin reactions according to whether the skin was or was not covered with the Perspex slab. On the other hand, a simultaneous study on the same patients showed that with these treatment conditions, a difference of dose of 20% caused a clear difference in skin reactions in 90% of the cases, and even a difference of dose of 10% could be clearly discriminated in 80% of the cases. Taking into account the existence of the dose build-up, one can conclude from these observations that a clinically significant increase of RBE between surface and 10 mm-depth is unlikely: an RBE increase of 10% and even probably of 5% could have been detected. These conclusions tend to confirm former results on chromosome aberrations and the sparse other available data of literature. The clinically observed skin sparing effect should then be related only to the dose build-up. One should point out that these conclusions, obtained in an electron beam which was not fully monoenergetic (as proved by the rather small build-up), are probably valid for the type of generator used, but have to be checked for other types of machines. (auth)

29906 CRITERIA FOR LIMITING RADIATION RISKS TO THE PUBLIC. Wheatley, B. M. (Central Electricity Generating Board, Berkeley, Eng.). Ann. Nucl. Sci. Eng.; 1: No. 9/10, 503-512(Sep 1974).

Radiological protection criteria used for setting limits to public radiation risks are considered. The formal basis of the criteria in current use is described with extensive reference to the recommendations used to formulate statutory limits. Attention is drawn to the limitations of the present concepts for use in estimating risks, and brief comments are made on likely future developments. It is shown that the current concepts used for defining acceptable industrial augmentations to the radiation environment of the general public are derived from a formalized set of dose limits. These do not provide an index of risk, furthermore the practical criteria used to supplement them are intended only to ensure that doses received do not exceed the limits. The practical criteria do not provide a means of adequately estimating doses received or risks incurred. Properly applied, with experience and professional judgement, the present criteria are useful in setting norms of good practice in design and operation. Because of inconsistencies in the dose limits, and the assumptions and approximations in estimating potential doses, any practical rules are necessarily imprecise, and a factor of safety is applied when it is necessary to be certain of working within statutory limits. The numerical interpretation of concepts based on dose limits will undergo continuous development mainly by advances in knowledge of the pathways to man, human metabolism, and in the mathematical procedures used for deriving organ doses from this data. However, the quantification of risks to population involves eliminating ambiguities in dose-risk relationships which are orders of magnitude greater than the error in dose estimations. (auth)

29907 CHROMOSOME DAMAGE AFTER RADIOTHERAPY. Braeman, J. (Velindre Hospital, Whitchurch, Cardiff, Eng.). Lancet; 1: No. 7903, 407(15 Feb 1975).

Chromosome preparations from over 200 patients with lung cancer have been studied before and after treatment by radiotherapy. Peripheral blood cultures set up using phytohemagglutinin to study changes in the immunological status of the patient brought about by treatment were also used to obtain chromosome preparations for the investigation of possible cytogenetic damage caused by irradiation. Six patients (3%) were found to have chromosome damage, consisting of dicentrics, acentrics, and fragments at the end of treatment and/or follow-up. Abnormalities were noted three and five months after the completion of treatment; no abnormalities were present before treatment. The small number of patients with demonstrable chromosome damage may be attributable to the techniques used for obtaining the chromosome preparations. These results therefore provided evidence for cytogenetic damage following small-field therapeutic irradiation. (UK)

29908 MORTALITY AND CAUSE OF DEATH IN JAPANESE RADIOLOGICAL TECHNICIANS, 1966 TO 1972. Kitabatake, T.; Watanabe, T. (Niigata Univ. (Japan). School of Medicine); Nakamura, M. Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 9, 440-443(Jun 1974). (In Japanese).

In 1966 to 1972, 134 deaths were recognized among Japanese radiological technicians belonging to the Japan Radiological Technicians' Association. This observed value is extremely less than that expected, which probably is due to an omission of case finding. Of 134, 6 skin cancers and 2 aplastic anemias were found. Both of these are significantly frequent as compared with the expected numbers. Leukemias were seen in 5 cases, but there was no statistically significant difference between the observed and expected values. The observed average year of death is 52.7 years, while the expected is 48.6 years. (auth)

29909 ON RADIATION INJURY OF THE DIGESTIVE ORGANS, PARTICULARLY THE COLON AND RECTUM. Takahashi, T.; Izumoi, S.; Matsubara, N.; Yamada, K. (Japanese Foundation for Cancer Research, Tokyo. Hospital). Shujutsu; 28: No. 4, 401-410(Apr 1974). (In Japanese).

In order to observe the radiation injury of the intestinal tract: (1) disease types from primary literatures and the change of the view on them were described; (2) the course of 2 months to 2 years and 6 months was observed for 56 patients who were examined at the Outpatient Department of the Research Institute for Cancer from January 1967 to October 1972 and were diagnosed by proctoscopy as having disturbances of the rectum due to radiation; (3) 19 cases are presented of indication of radiation injury of the intestinal tract treated surgically at the Department of Surgery by the end of 1972; and (4) 323 cases of operative indication with radiation injury of the intestinal tract were totalled by questionnaire survey in 75 main surgical institutions all over Japan for examination with 4 items in the prognostic survey. As a result, differentiation of whether each change due to radiation injury was a change due to radiation itself, or to malignant tumor, the primary disease, posed a problem. The prognosis in the nationwide totalling was characterized by the large number of deaths within one year. Of the cases of uterine cancer treated with radiation at the Department of Gynecology of the Research Institute for Cancer, cases with operation of the digestive organs after radiotherapy were roughly divided into deaths with a survival period of less than 2 years and survival cases living for more than 5 years. Based on those characteristics, changes of the intestinal tract seem to include those due to malignant tumor itself in a considerable number of cases in addition to changes due to radiation. For (4), cases of bleeding, ileus, fistula, and peritonitis were tabulated. (JA)

29910 THE LATE EFFECTS OF IRRADIATION IN CHILDHOOD. Watanabe, T.; Izuno, I.; Ohata, T. (Shinshu Univ., Nagano (Japan). Faculty of Medicine). Shoni Geka Naika.; 6: No. 2, 192-193(Feb 1974). (In Japanese).

Two cases are reported showing abnormalities in the bone and blood vessels as late effects of radiotherapy carried out in their infant periods. One of them was a 13-year-old girl who received about 2,000R x-ray irradiation of 180KV in the abdomen after the operation for removal of a Wilms's tumor at 6 months after birth. About 12 years after the irradiation, edema appeared in the left leg, and phlebography revealed conspicuous stricture of left iliac vein. Another case was a girl of the same age who received total dose of 10,000R tele-Co irradiation from left part of the mandible to the cervical part, based on the diagnosis of lymphangioma at the age from 4 to 7. About five years after the irradiation, hemiplegia appeared on the left side of her body. Routine roentgenography of the face showed conspicuous atrophy in the left side of the mandible, and left carotid angiography showed conspicuous stricture of some area of the external carotid artery. These two cases indicated that even a considerably small dose of irradiation in infancy has the possibility to give adverse effects on blood vessels as well as bone. (JA)

29911 PROBLEMS ON THE EFFECT OF FAINT RADIATION. Doke, T. (Waseda Univ., Tokyo (Japan). Science and Engineering Research Lab.). Kagaku (Tokyo); 44: No. 5, 308-313(May 1974). (In Japanese).

The effects of long-term exposure of the human body to low-level radiation is described. Although exposure doses were measured in Kerala, the west seaside of India with a great amount of natural radiation, no significant findings on the effect of low-level radiation on the human body were obtained from these statistical investigations. Therefore, the incidence of leukemia and the relationship between the exposure in fetus within the mother's body and infant cancer were studied on the basis of the survey report on exposures in Hiroshima and Nagasaki. Synergistic effects of radiation and other carcinostatic factors (ethionine,

smoking etc.), and the relationship between the dose and effect were also examined. (JA)

Vertebrates

Refer also to abstracts 29805, 29962, 30037, 32397, and 32400.

29912 (AED-CONF-74-494-001) IN VIVO INVESTIGATIONS ON THE RELATIVE RADIOSENSITIVITY OF HYPOXIC TUMOR CELLS WITHIN THE LET RANGE OF 0.5 TO 150 keK/μ. Porschen, W.; Feinendegen, L. E.; Muehlensiepen, H.; Bosiljanoff, P.; Piepenbring, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Medizin). 1974. 5p. (In German). INIS.

From 5th scientific symposium of the Deutsche Gesellschaft fuer Medizinische Physik e.v.; Essen, F. R. Germany (8 Oct 1974).

8 figs.; 5 refs.

In order to measure γ-emitting DNA isotopes bound to the tumor, a special measuring unit was constructed, where the body of the animal is screened and only the radiation from the tumor region is registered. After a single injection of iodine-labeled desoxyuridine in tumor-carrying mice and a tumor irradiation with 5000 R γ radiation, the activity loss for the tumor-bearing leg, for the tumor, the DNA protein complex in the tumor, and for the tumor skin were separately determined. The turnover rate of the activity in the tumor leg and that of the DNA protein complex were directly comparable with one another after 100 hours. In order to determine the different radiosensitivities of hypoxic and enoxic tumor cells in vivo, a specially developed double labeling technique was used. For this, 20 μCi of ^{123}I-desoxyuridine were injected i.v. in one or two injections with a 7-hour gap. After 50 to 70 hours, desoxyuridine labeled with ^{131}I was injected. The tumors some 20 hours later were locally irradiated with various types of radiation (^{137}Cs γ radiation, 15-MeV neutrons, 200-keV/μ α particles). The activity loss in the nonirradiated sarcoma 180 showed a biological half-life of 100 to 140 hours. After gamma irradiation, an increased, dose-dependent regression was observed with the hypoxic cells exhibiting a lower radiosensitivity. On irradiation with 15-MeV neutrons, the difference in radiosensitivities between enoxic and hypoxic cells was less marked. No difference was found between the ^{125}I or between the ^{131}I-labeled cells at α-doses of 340 and 680 rads. The radioinduced increase of the cell loss rates showed a clear dependence on the LET value. (GE)

29913 (COO-3017-20) RADIATION CARCINOGENESIS. Progress II, 15 March 1974–15 March 1975. Warren, S.; Gates, O. (New England Deaconess Hospital, Boston, Mass. (USA). Cancer Research Inst.). 1975. Contract AT(11-1)-3017. 16p. Dep. NTIS $4.00.

In parabiont rats, one irradiated, one shielded, 75 percent of the older irradiated partners showed tumors at death, twice as many as in controls, and developed tumors 60 days earlier. Following unilateral nephrectomy in these parabiont rats the nonirradiated partners developed breast carcinomas fivefold as often as did the irradiated, probably due to altered estrogen secretion. A high incidence of osteogenic sarcoma was found in the irradiated parabiont partner. Single control rats lived 700 days untreated but only 13 days when x-irradiated (1000 R). Parabiosis permitted survival to 452 days average. Control parabiont pairs lived 635 days. Mammary cancer in mice following radiation results from interaction of factors: radiation, hormonal imbalance, and presence of mammary tumor virus; none decisive. Induction of mammary cancer was highest from 30 to 500 R, also optimal for ovarian tumorigenesis. However, there was no correlation between the two lesions. Radiation triggers the systemic changes which result in mammary cancer. Our transplantable radiation-induced pheochromocytoma continues to serve as a model of the disease in man. Work in leukemia has been transferred to National Institute of Health grant support. Following irradiation the adrenal cortex of RAP mice tends to show proliferation of A cells. (auth)

29914 HOST RESISTANCE MECHANISMS TO NEWCASTLE DISEASE VIRUS IN IMMUNODEFICIENT CHICKENS. Perey, D. Y. E.; Dent, P. B. (McMaster Univ., Hamilton, Ont.). Proc. Soc. Exp. Biol. Med.; 148: No. 2, 365-369(Feb 1975).

In order to assess the mechanisms of host resistance to Newcastle disease virus (NDV), the susceptibility of young adult normal, T cell deficient and agammaglobulinemic chickens to an avirulent live vaccine (BI) and a mesogenic strain of NDV was studied. All animals, regardless of immunological status resisted the vaccine strain. Most normal birds resisted mesogenic NDV, however T cell deficient birds were much more susceptible and agammaglobulinemic chickens were extremely susceptible. There was no difference in the kinetics and levels of hemagglutination-inhibition activity of plasma between normal, control-irradiated, and T cell deficient birds nor between dying and surviving birds. Agammaglobulinemic chickens could be partially protected against an otherwise lethal challenge following immunization with avirulent NDV, low doses of mesogenic NDV inoculated intranasally or im injection of β-propriolactone inactivated NDV mixed in complete Freund's adjuvant. The possible mechanisms for this protection together with the relative roles of humoral, cell mediated, and nonspecific immunity are discussed. (auth)

29915 RESIDUAL RADIATION DAMAGE IN MOUSE SKIN 5 TO 8 MONTHS AFTER IRRADIATION. Denekamp, J. (Mount Vernon Hospital, Northwood, Eng.). Radiology; 115: No. 1, 191-195(Apr 1975).

Residual injury from large doses of x-rays or neutrons given 5 to 8 months earlier was assessed by the response of the skin to further doses of 250 kV x rays. The "dose remembered" was assessed by single test doses. Two doses separated by 24 hours or 7 days were given to assess the capacity for repair to sublethal injury and recovery by proliferation. About 10% of the pretreatment dose was remembered 5 to 8 months later. The capacity for repair of sublethal injury and proliferation was similar in controls and animals receiving 1000 to 3000 rads as pretreatment. These results apply to basal layer epidermal cells and may differ from those of more slowly dividing populations. (auth)

29916 CULTURE OF AUTOLOGOUS BONE MARROW IN DIFFUSION CHAMBERS: EFFECT OF HOST IRRADIATION. Laissue, J. A.; Chanana, A. D.; Chronkite, E. P.; Joel, D. D.; Pavelec, M. (Brookhaven National Lab., Upton, NY). Blood; 45: No. 3, 417-425(Mar 1975).

Autologous bone marrow (BM) cells were cultured in diffusion chambers (DC) implanted into whole-body irradiated, nonirradiated, or sham-irradiated goats. Proliferation was apparent in DC implanted in both irradiated and nonirradiated goats. However, cells in DC cultured in irradiated hosts increased in number beginning earlier, proceeded at a faster rate, and reached higher numbers than in DC in nonirradiated hosts. Growth enhancement could not have occurred as a result of radiation-induced immunosuppression in autologous hosts. The nonirradiated "target cells" in the DC therefore constituted an indicator system for stimulatory or inhibitory substances in the host. The simultaneous increase in the number of granulocytes in peripheral blood and in DC of irradiated hosts was paralleled by an initial rise in serum colony-stimulating factor (CSF). A second, prolonged period of severe granulocytopenia following irradiation of the host correlated with high levels of serum CSF. Increased numbers of megakaryocytes were seen in DC as thrombocytopenia developed in the irradiated host. DC erythropoiesis disappeared rapidly in nonirradiated goats; however, in DC of irradiated goats, the number of erythrocytic precursors increased exponentially during ablation of host erythroid marrow. Anemia did not develop in the host during the culture period. Proliferation of mononuclear cells in DC was markedly stimulated by irradiation of the host. Proliferation of macrophages appeared independent of host treatment. These observations provide strong evidence for diffusion of specific and/or nonspecific humoral hematopoietic stimulators from the host into the DC. This stimulation appears to be elicited and/or intensified by irradiation of the host. (auth)

29917 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. II. Cell Viability of the Vessel Wall. Reinhold, H. S. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). Curr. Top. Radiat. Res.; 10: No. 1, 9-28(Jun 1974).

Part of the radiation response of the blood vessels may be secondary to cell sterilization. Investigations on the radiosensitivity of the endothelial cells are reviewed. The capillary endothelial cells in the rabbit heart show an increased rate of proliferation a few months after irradiation. Microcirculatory studies show effects that are probably transient, such as early oedema of endothelial cells, vasodilatation, thrombosis and signs of increased permeability. These phenomena can be studied by the in vivo type of microcirculation preparations and by the electron microscope. (NL)

29918 INFLUENCE OF RADIATION ON BLOOD VESSELS AND CIRCULATION. XI. Blood Flow and Permeability After Whole Body Irradiation. Dunjic, A. (Univ., Louvain, Belgium). Curr. Top. Radiat. Res.; 10: No. 1, 170-184(Jun 1974).

Studies on blood flow and permeability changes after whole-body irradiation are reviewed. A few studies support the conclusion that the increased disappearance rate of albumin from the circulation after whole body irradiation is due to a reduced extravascular return rather than to an increased transcapillary rate. The transient increase in capillary fragility and vascular reactivity are reported to coincide with the incidence of the acute radiation syndrome in whole body irradiated animals. It

is recalled that fluctuations in tissue-blood exchanges described as evidence for altered capillary permeability, may not involve actual changes in the capillary wall, but can be attributed rather to extrinsic phenomena in hydrostatic pressure, factors regulating peripheral blood flow and avidity of extracapillary tissue for either solute or solvent under normal or experimentally induced conditions. (NL)

29919 QUANTITATIVE ASSESSMENT OF RADIATION AND HYPOTHERMIA–HYPERCAPNIA INTERACTION EFFECTS ON THE FORMATION OF THE FETAL RAT CEREBRAL CORTEX. Brizzee, K. R.; Ordy, J. M.; Kaack, B. (Tulane Univ., New Orleans). Radiat. Res.; 61: No. 3, 405-416(Mar 1975).

In the formation of the fetal rat cerebral cortex, undifferentiated cells proliferate in the primordial ependemyl layer on day 13 of gestation and begin to migrate through the intermediate zone on day 14 to form the cortical plate. The aims of this study were to evaluate whole-body gamma radiation (50, 100, 150, 200 R) and hypothermia–hypercapnia exposure on the 13th day of gestation on the formation of the cortical hemispheres on day 19 of gestation. Fetal brains were removed and subjected to qualitative and morphometric assessment of the various exposure effects on cellular and tissue derangements in the cerebral hemispheres and the cross-sectional area ($\mu m \times 10^4$) of the cortical plate. Dose-dependent cellular and tissue derangements were observed in the cortical wall and in the mean cross-sectional area of the cortical plate. Significantly lesser effects on the cerebral hemispheres and cortical plate were observed after two fractionated exposures, with an intervening 6-hr interval, than with single equivalent doses. Hypothermia–hypercapnia alone had no observable effects. Hypothermia–hypercapnia interposed in the 6-hr interval between fractionated exposures resulted in greater damage, comparable to single rather than lesser fractionated dose effects. The single-fractionated dose differences and hypothermia–hypercapnia reversal of fractionated dose decreases were interpreted as an inhibition of repair or recovery in the formation of the fetal rat cortical plate. (auth)

29920 EFFECTS OF 1000 RADS ^{60}Co ON BARORECEPTOR REFLEX RESPONSES TO PHENYLEPHRINE AND CAROTID OCCLUSION IN MONKEYS. Bruner, A.; Neely, A. W.; Henderson, E. A.; Weiss, G. K. (Lovelace Foundation, Albuquerque, NM). Radiat. Res.; 61: No. 3, 393-404(Mar 1975).

Failure of the baroreceptor reflex mechanisms was proposed as a basis for the early hypotension seen in monkeys after high-dose, whole-body irradiation. The present work involved the testing of baroreflex sensitivity by carotid occlusion and phenylephrine injection before and after 1000 rads ^{60}Co in nine unanesthetized, restrained monkeys. During the early postradiation minutes, at the time of deepest hypotension, both the baroreflex tests revealed depressed baroreflex sensitivity (diminished blood pressure and heart rate responses). After 8 to 15 min postirradiation, the phenylephrine, but not the occlusion, test demonstrated a reversal to significant baroreflex hypersensitivity which persisted 24 hr or more. Early shifts in the set level relation between blood pressure and heart rate also occurred after irradiation. No failure of the baroreflex mechanisms was evident, in contradiction to a previous finding. (auth)

29921 LYMPHOID CELL ADENYLATE CYCLASE ACTIVITY AFTER X-IRRADIATION AND CORTISONE TREATMENT. Kemp, R. G.; Duquesnoy, R. J. (Medical Coll. of Wisconsin, Milwaukee). J. Immunol.; 114: No. 2, 660-664(Feb 1975).

Cortisone injection and x-irradiation of normal mice lead to extensive destruction of thymus and spleen lymphocytes. The lymphocytes resistant to these treatments have basal adenylate cyclase activities that are the same as or slightly lower than the cells of untreated animals. On the other hand, the ability of the cyclase of the cortisone-resistant and radioresistant lymphocytes to respond to stimulation by epinephrine is greatly diminished. The results provide an explanation for the previously observed lack of epinephrine sensitivity of the cyclase of lymphoid cells of immunodeficient pituitary dwarf mice and suggest that the depressed lymphoid cell population of the dwarf is the result of an inability to recover from stress-related lymphoid involution. It is also suggested that the more mature population of lymphoid cells of normal mice is less responsive to hormonal influences. (auth)

29922 UPTAKE OF ^{86}Rb IN MOUSE KIDNEYS IRRADIATED WITH FRACTIONATED DOSES OF X RAYS. Glatstein, E.; Brown, R. C.; Zanelli, G. D.; Fowler, J. F. (Mount Vernon Hospital, Middlesex, Eng.). Radiat. Res.; 61: No. 3, 417-426 (Mar 1975).

The extraction of intravenously administered ^{86}Rb in C3H mouse kidneys 4 mos after irradiation was used as a measure of renal blood flow. Seven fractionation schedules of 240-kV x rays were employed with over-all times of either 4 or 18 days, using 4, 5, 6, 9, or 15 equal dose fractions. The reduction in ^{86}Rb uptake was found to be similar after 2000 rets given as 5 fractions in 4 days (5F/4d) or 9F/4d as after 1900 rads given as a single dose. For equal ret doses administered in 5 or 9 fractions (24-hr or 12-hr intervals, respectively) over 4 days, the reduction in ^{86}Rb uptake was almost identical. After 4, 6, 9, and 15 fractions in 18 days, however, a significantly smaller effect was found than in the 4-day schedules for similar ret doses. No increase in the thymidine labeling index of the tubule cells in irradiated kidneys was seen. These results indicate that fractionated irradiation reduces perfusion to the kidneys in a predictable fashion. They also suggest that, for this system, the fraction exponent in the Ellis formula appears to be valid, but the time exponent of the formula was not confirmed. Possible explanations for this finding are discussed. (auth)

29923 MEASUREMENT OF BLOOD FLOW IN THE MOUSE TAIL AFTER IRRADIATION. de Ruiter, J.; van Putten, L. M. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Radiat. Res.; 61: No. 3, 427-438(Mar 1975).

The measurement of the local clearance rate after subcutaneous injection of ^{133}Xe and [^{51}Cr]EDTA provided a way to obtain information on blood flow and capillary diffusion capacity (CDC) in the mouse tail. These studies were performed under normal resting conditions and after the induction of maximal blood flow. A decrease in blood flow and CDC was observed about a year after tail irradiation with a single dose of 3000 rad x rays. This decrease was most significant under maximal blood flow conditions. The dose-effect curves for single doses when measured at 14 to 17 mo after irradiation showed a decrease in blood flow up to 2500 rad; whereas, after doses higher than 2500 rad, an increase in blood flow was observed. The same phenomenon was observed with the CDC; however, it was less pronounced. Studies of blood flow and CDC after fractionated irradiations demonstrated no significantly different curves, if the doses were expressed in ret. This indicates that the Ellis formula is a satisfactory predictor of fractionation effects on later functional blood vessel damage. (auth)

29924 VITAMIN E DECREASES ERYTHROCYTE FRAGILITY AFTER WHOLE-BODY IRRADIATION. Hoffer, A.; Roy, R. M. (Concordia Univ., Montreal). Radiat. Res.; 61: No. 3, 439-443 (Mar 1975).

Subsequent to weaning, male Swiss Albino mice were administered a Vitamin E-supplemented diet or a low Vitamin E diet. After 43 days on the respective diets, half the subjects in each group were exposed to 500 rads from a 230 kVp x-ray machine at a dose rate of 25 rads/minute. Mice were sampled at various times post-irradiation. Vitamin E deficiency was confirmed by the Rose-György hemolysis test. A test for spontaneous hemolysis was employed to assess erythrocyte fragility. Erythrocytes from subjects in the irradiated deficient group usually exhibited greater fragility. The least fragile erythrocytes were generally found to be those from subjects in the irradiated supplemented group. A statistically significant radiation effect, Vitamin E effect, and interaction term were obtained. (auth)

29925 DOSE-RESPONSE RELATIONSHIPS FOR THE PRODUCTION OF BODY MALFORMATIONS IN TROUT BY EXPOSURE OF SPERM TO LOW DOSES OF RADIATION. Newcombe, H. B.; McGregor, J. F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiat. Res.; 61: No. 3, 519-525(Mar 1975).

Exposure of sperm of the rainbow trout to ionizing radiation causes, in addition to major eye anomalies, gross malformations of the bodies of embryos. At the lower doses the observed yields of body malformations exceed those for the unirradiated controls but the difference falls short of statistical significance. At the higher doses the radiation effect is large and highly significant. Unlike the eye malformations, which increase in frequency in direct proportion with the radiation dose, the body malformations exhibit a disproportionate increase with increasing dose. Some of the malformations of fish embryos affect more than one part of the body, and in this respect resemble the multiple malformations and syndromes of human infants. (auth)

29926 EVOLUTION OF SOME CONSTITUENTS OF BONE CALLUS IN MICE AFTER WHOLE-BODY IRRADIATION. Effect of Cystamine. Drouet, J.; Pleinard, J. F.; Nguyen, T. L.; Retbi, J.; Goyffon, M. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France). Div. de Biologie Generale et Ecologie; Museum National d'Histoire Naturelle, 75 - Paris (France)). Compt. Rend. Soc. Biol.; 168: No. 1, 14-18(1974). (In French).

Consolidation of broken bones is delayed by whole-body irradiation, and contents of bone callus in collegen and minerals are reduced. The alterations are proportional to intensity of irradiation and not corrected by cystamine. (FR)

29927 INVESTIGATIONS ON COMBINED INJURIES. Changes in Radiosensitivity of the Bone Marrow Cells of Mice Having Been Charged with Whole-Body Irradiation Combined with Open Skin Wounds. 20. Communication. Tott, K. R.; Messerschmidt, O. (Laboratorium fuer Experimentelle Radiologie, Neuherberg/ Muenchen (F. R. Germany)). Strahlentherapie; 148: No. 4, 381-385(Oct 1974). (In German).

The hematopoietic stem cells of mice after x irradiation with 200 to 700 R or infliction with an open dorsal skin wound and irradiation two days later with the same doses were investigated. Whereas with the exogenous CFU technique no significant differences between the dose effect curves of only irradiated mice and those inflicted with combined injuries could be found, the endogenous CFU technique provided three times higher numbers of CFU nodules in the spleen. This finding can be interpreted as the result of an increased proliferation of the hematopoietic tissue. Evidently an additional open wound exerts a stimulating effect on the stem cells of irradiated animals. (auth)

29928 SOLCOSERYL AS A POWERFUL RADIOPROTECTIVE COMPOUND. Bauer, D.; Locker, A. (Oesterreichische Studiengesellschaft fuer Atomenergie G. m. b. H., Seibersdorf. Inst. fuer Biologie). Nucl. -Med.; 13: No. 3, 258-266(Nov 1974).

In adult inbred mice the blood extract Solcoseryl, when applied singly intraperitoneally or perorally, is able to protect over a comparatively large dose range against γ irradiation of a lethal dose whereby up to 100% survivors are obtained (as compared with practically no survival in the untreated, only irradiated animals of the control series). The effect of a low dose of Solcoseryl eliciting only approx. 50% survivors among the animals can be improved up to 100% if the animals were subject to heat adaptation for a period of 6 weeks prior to the Solcoseryl treatment and irradiation and heat adaptation continued during the subsequent observation time. (auth)

29929 TUMOR SYNCHRONIZATION BY MICROWAVES. Animal Experiments Concerning Susceptibility of Proliferation Kinetics of the Tumor in Vivo to Non-Ionizing Radiation. Dietzel, F. (Giessen Univ. (F. R. Germany). Nuklearmedizinische Abt.). Strahlentherapie; 148: No. 5, 531-542(Nov 1974). (In German).

The dynamics of radiophosphorus incorporation into tumors can be used to demonstrate how short-term high-frequency therapy can have a synchronizing effect on tumor proliferation in vivo. Utilization of this effect might be of importance to both radiotherapy and chemotherapy. (auth)

29930 CITRIC ACID AND PHOSPHOROUS-32 (^{32}P) ACTIVITY IN ALCOHOL SOLUBLE FRACTION OF RAT PROSTATE AND SEMINAL VESICLES AFTER LOCALIZED GAMMA IRRADIATION OF TESTES. Gupta, G. S.; Bawa, S. R. (Punjab Univ., Chandigarh (India). Dept. of Biophysics). Strahlentherapie; 148: No. 4, 420-423(Oct 1974).

2 figs.; 12 refs.

Citric acid and ^{32}P activity in alcohol soluble fractions in prostate and seminal vesicles were determined after radiation castration in rats. Enhanced levels of citric acid and ^{32}P during the first week suggest higher androgen contents in the plasma, whereas subsequent depleted values during the second week indicate a reduced androgen synthesizing capacity of radiated testes. Following the third week, there is a tendency for recovery of citric acid in prostate suggesting that the androgen levels are normalized during the fourth week of radiation castration. The role of citric acid in phospholipid synthesis in accessory organs of rats has been suggested. (auth)

29931 IMMEDIATE CONTRACTILE RESPONSES OF GUINEA-PIG URINARY BLADDER IN SITU TO X IRRADIATION. Michailov, M. C.; Welscher, U. E.; Kuemper, H. J. (Gesellschaft fuer Strahlen- und Umweltforschung m. b. H., Neuherberg/ Muenchen (F. R. Germany). Inst. fuer Biologie; Muenchen Univ. (F. R. Germany). 2. Frauenklinik). Strahlentherapie; 148: No. 4, 409-412(Oct 1974).

2 figs.; 4 refs.

A relatively simple method is described for investigations with optical and ionizing radiation on the guinea pig urinary bladder in situ in acute experiments. The bladder reacted to x rays (50 kV, 0.3 mm aluminium) at a dose rate of 3 kR/min at a threshold dose of 5 kR with a reversible increase in muscle tone and phasic activity. Atropine (1 mg/kg, i.v.) had no influence on the x-ray induced tonic contraction, but Spasmex (0.015 mg/kg) reduced, and procaine (50 mg/kg) and hexamethonium (1 mg/kg) slightly potentiated the reaction. (auth)

29932 THE INFLUENCE OF OZINE ON TUMOR GROWTH AND RADIATION EFFECT. Experiments on the Ehrlich Tumor. Hoppe, G. Erfahrungsheilkunde; 23: No. 5, 159-165(May 1974). (In German).

5 figs.; 3 tabs.; 46 refs.

Firstly, the compatability of ozone with i.p. administration to female albino mice and the compatability of linoleic acid contained food (7.5%) to normal and Ehrlich tumor bearing animals has been investigated. With good compatability, the oil food and ozone effect of various dosage (0.007; 0.07 and 0.7 γ ozone g/d) and the effect of a single partial body irradiation of 200 R on the tumor growth are tested. It is shown that unsaturated fatty acids, in particular the linoleic acids and the peroxides arising from them, are radiomimetic substances. Ozone and the peroxides arising from its effect are also radiomimetic substances which only lead to a distinct growth inhibition at low dosage. A toxic effect on the organism is to be expected with higher doses. The combination of oil food and ozone results in a smaller tumor weight except for the group treated with the lowest ozone dose and the non-irradiated group. A varied effect of the peroxides formed with and without ozone is probable here. The radiation effect on the growth of the tumor showed a direct dependence on the tumor weight of the non-irradiated group. An optimal effect is achieved by the daily administration of 0.007 γ ozone/g plus normal food or also 0.07 γ ozone/g plus oil food, a radiation effect is not seen. There will probably be toxic effects at higher doses of ozone and oil food. The more local effect of a partial body irradiation then leads to the inhibition of tumor growth in these groups. (GE)

29933 SKIN TOLERANCE IN RABBITS TO ALPHA PARTICLE AND LOW-ENERGY ELECTRON IRRADIATION. Lippincott, S. W.; Wilson, T. D.; Bender, R. (Virginia Commonwealth Univ., Richmond (USA). Medical Coll.; Citadel (Military Coll. of South Carolina), Charleston (USA). Dept. of Physics). Strahlentherapie; 148: No. 3, 313-319(Sep 1974).

2 figs.; 1 tab.; 19 refs.

Tissue tolerance of rabbit skin to irradiation from 2.1 MeV electrons penetrating 0.8 cm was compared to that of alpha particles of 130 MeV penetrating 0.6 cm and of 180 MeV penetrating 1.27 cm. The average LET (keV/micron) for the electrons was 0.2, for the 130 MeV alpha particles 6.9 at the skin surface, and 14.5 at the Bragg peak, while for the 180 MeV alpha particles the values were 5.3 and 14.7, respectively. Electrons required larger doses to produce erythema and ulceration than did alpha particles of either energy use. Healing occurred following doses of electrons for which, at similar doses, it did not occur with the alpha particles. The extent of the skin reaction following alpha particle bombardment, at single doses up to 3,000 rad, is within reasonable tolerance limits indicating that a therapeutic trial using a rabbit neoplasm is warranted. (auth)

29934 CHANCE OF THE CONTENT OF SEROTONIN AND MEXAMINE IN THE BLOOD FOLLOWING THE ADMINISTRATION OF THESE COMPOUNDS TO IRRADIATED RATS. Katsev, V. M.; Demchenko, V. M.; Golubentsev, D. A. (Military Medical Academy, Leningrad). Farmakol. Toksikol.; No. 4, 440-443(16 Jan 1973). (In Russian).

The dynamics of the level of serotonin and mexamine in the blood of intact and irradiated (600R) rats after their intravenous injection with these substances in the form of creatinine-sulfate and adipinate serotonin in a dose of 0.5 mg/kg (with reference to the base), and mexamine hydrochloride in a dose of 2.5 mg/kg, were studied. In a separate series of experiments, mexamine was introduced into the stomach in amounts of 42 and 167 mg/kg. The extent and duration of the content of serotonin in the blood depended upon the thrombocyte level. It was found that the content of serotonin in the blood decreases from the 6th to the 16th day after irradiation. Intravenous administration of serotonin to irradiated rats on the 9th to 10th day after irradiation brings about only a brief normalization of its content in the blood. During the intravenous administration of mexamine in doses of 0.5 to 5 mg/kg, its rapid disappearance from the blood stream was noted. The dynamics of the content of mexamine in the blood of intact and irradiated rats is essentially the same. The introduction of mexamine into the stomach of irradiated rats (42 mg/kg) is accompanied by its rapid absorption and its appearance in the blood in the maximal concentration by the 15th minute after its introduction. The content of mexamine in the blood decreases considerably by the end of the third hour. The peroral mexamine dose of 167 mg/kg was lethal. (JPRS)

29935 INFLUENCE OF SOME ANTIOXIDANTS OF THE PHENOL SERIES UPON THE DEVELOPMENT OF THE INTESTINAL FORM OF RADIATION SICKNESS IN MICE. Nestorenko, V. S.; Suminov, S. I.; Gurvich, Ya. A.; Styskin, E. L.; Kumok, S. T. (Inst. of Medical Radiology, Obninsk, USSR). Farmakol. Toksikol.; No. 4, 443-446(26 Jul 1973). (In Russian).

The effect of 2,6-di-tret-butyl-4-methylphenol (ionol) (preparation I), 2,6-di-tret-butyl-methoxylmethylphenol (preparation II), and 2-tret-butyl-α-methylbenzyl-4-methylphenol (preparation III) on the development of the intestinal form of radiation sickness in mice was studied. After their single whole-body irradiation in a

dose of 1000 R, 30 mg/kg of preparation I, 40 mg/kg of preparation II or 5 mg/kg of preparation III were introduced subcutaneously into white mice. The first two substances retarded the development of radiation injury of the small intestine and doubled the average life-span of irradiated mice with the intestinal form of acute radiation sickness, but did not exert any influence upon the injury to the blood-formation system. Preparation III reduced the destruction of leukocytes and spleen cells, retarding radiation injury to the blood system, but exerted virtually no influence at all upon the injury to the intestinal tract. (JPRS)

29936 DIFFERENTIAL IgA REPOPULATION AFTER TRANSFER OF AUTOLOGOUS AND ALLOGENEIC RABBIT PEYER'S PATCH CELLS. Rudzik, O.; Perey, D. Y. E.; Bienenstock, J. (McMaster Univ., Hamilton, Ont.). J. Immunol.; 114: No. 1, 40-44(Jan 1975).

The distribution and differentiation of rabbit Peyer's patch cells were studied in lethally x-irradiated autologous and allogeneic recipients, 6 days after i.v. transfer. Immunoglobulin Ig-containing cells were detected in both frozen tissue sections and fixed smears of single cell suspensions of spleens using monospecific anti-α, -μ, and -γ antisera in direct immunofluorescence. The tissues of lethally x-irradiated rabbits which had not received any cells were almost devoid of Ig-containing cells whereas the intestinal lamina propria of both autologous and allogeneic Peyer's patch cell recipients had approximately equal numbers of predominantly IgA-containing cells. In the spleen of allogeneic recipients, many large colonies of IgA-containing cells were seen and these cells made up 4.6 to 16.9% (mean 8%) of all spleen cell suspension. The spleens of autologous recipients contained fewer and smaller colonies of IgA cells which made up only 0.5% of all cells in spleen cell suspensions. The numbers of IgM- and IgG-containing spleen cells were small in all animals, however, recipients of allogeneic Peyer's patch cells had four to five times as many as either non-reconstituted lethally irradiated rabbits or autologous recipients. These data confirm that rabbit Peyer's patches are relatively rich in precursors of IgA-producing cells and suggest that histocompatibility differences may either potentiate differentiation of IgA production or lead to trapping of allogeneic Peyer's patch cells in the spleen. Although these experiments did not elucidate the mechanisms of differentiation of IgA-producing cells, the fact that no differences were seen between numbers of IgA cells in gut lamina propria after either autologous or allogeneic cell transfer suggest that different mechanisms may be responsible for appearance of these cells in gut and spleen. (auth)

29937 HOST-DERIVED ANTIBODY-FORMING CELLS IN LETHALLY IRRADIATED MICE. Pilarski, L. M.; Cunningham, A. J. (Australian National Univ., Canberra). J. Immunol.; 114: No. 1, 138-140(Jan 1975).

The technique of adoptively transferring an immune response by injecting donor cells into irradiated recipient mice is based on the assumption that the host is rendered immunologically inert by irradiation. We present evidence that these mice are not inert; in the presence of donor cells of various types they mount a substantial immune response against both heterologous erythrocytes and dinitrophenylated bovine serum albumin. This restoration of the host requires donor cells for its expression and can account for up to 100% of the total response. The problems associated with this finding are discussed. (auth)

29938 RAT-MOUSE RADIATION CHIMERAS: CHARACTERIZATION OF AN ANTIBODY-MEDIATED GRAFT-VS-HOST REACTION. Kateley, J. R.; Gengozian, N. (Oak Ridge Associated Universities Inc., TN). J. Immunol.; 114: No. 1, 125-132(Jan 1975).

A modification of the Jerne hemolysis-in-agar technique was used to demonstrate antibody-mediated graft-vs-host (GvH) hemolytic activity in lymphoid tissues of rat-mouse radiation chimeras. Initial foci of hemolytic activity were detected on the 3rd day in spleens of lethally x-irradiated mice infused with rat spleen cells (950 R-RSp chimeras). The peak GvH foci response occurred near the end of the 1st week when 70% of 950 R-RSp chimera spleens examined contained an average of 18 to 21 foci per spleen. GvH hemolytic activity was also detected in mice reconstituted with rat bone marrow (950 R-RBM chimeras); however, only 40% of these chimeras contained splenic foci (nine foci per spleen) on day 8, the peak day of response. Mesenteric lymph nodes from 950 R-RSp chimeras, but not 950 R-RBM chimeras, also contained GvH hemolytic foci. Specificity experiments demonstrated that the GvH hemolytic reaction could be inhibited with rabbit anti-rat IgM serum and host ($C3BF_1$) antigenic cell fragments. Indirect (IgG) hemolytic activity was also observed in spleens of 950 R-RSp chimeras 6 to 10 days after treatment. At least 90% of indirect foci appeared coincident with direct foci. Rat IgM and IgG containing cells beneath hemolytic foci were observed by combining the fluorescent antibody and foci techniques. To determine whether the foci response reflects an in vivo sensitization of donor cells, spleen cell transfer experiments were done. The results indicate that spleen cells from 950 R-RSp chimeras were more effective in accelerating mortality and anemia and induced a higher incidence of Coombs' positive red cells in lethally irradiated isogeneic recipients than spleen cells from 950 R-RBM chimeras; spleen cells from either chimera were more effective in accelerating GvH indices than spleen and marrow cells from normal rats. (auth)

29939 RELATION OF DNA SYNTHESIS AND SUPPRESSION TO DEVELOPMENT OF MEMORY BY T CELLS. Mills, V. A.; Orbach-Arbouys, S.; Gershon, R. K. (Yale Univ., New Haven). J. Immunol.; 114: No. 1, 200-205(Jan 1975).

Parental thymocytes, inoculated into lethally irradiated F_1 mice, synthesize DNA in response to the histocompatibility antigens of the reciprocal parent in the F_1 cross. The DNA synthetic response is characterized by a 1 to 3 day latent period and a 1- to 2-day period of peak activity which is followed by a sharp decline. Cells transferred to secondary recipients at the time of peak activity in the primary hosts respond only minimally in the spleens of the secondary hosts. Cells transferred 1 day later, when DNA synthetic activity in the primary hosts is sharply curtailed, exhibit striking secondary responsiveness. Thus, the decline in activity in the primary host is not due to the loss of potentially reactive cells from the spleens. It seems more likely that the preceding response creates a suppressive milieu in the primary host. The inability to transfer significant secondary responsiveness with cells harvested at the time of peak activity in primary hosts suggests that the acquisition of memory by these cells requires more than their clonal expansion. The occurrence of an additional differentiational event is suggested by the correlation of a marked increase in memory with the sharp cessation of the primary DNA synthetic response. (auth)

29940 BACTERIAL AND BIOCHEMICAL STUDIES ON GAMMA-IRRADIATED SWINE. Eisele, G. R. (Univ. of Tennessee, Oak Ridge). Amer. J. Vet. Res.; 35: No. 10, 1305-1308(Oct 1974).

Six healthy 8-month-old Duroc barrows weighing 90 to 113 kg each were multilaterally exposed to 966 R of γ-radiation at the dose rate of 10.5 ± 0.6 R/hour and were evaluated for bacteriologic, hematologic, and blood serum alterations. A bacteremic state was not detected in 1 barrow. One barrow yielded isolates twice, and bacteremia developed terminally in the remaining barrows. At necropsy, the irradiated barrows yielded a greater number and variety of bacteria from muscles and organs than did the controls. All irradiated barrows had fewer circulatory leukocytes, blood platelets, lymphocytes, and neutrophils. Lactic dehydrogenase activities increased ($P < 0.05$) during the first 23 hours of irradiation and decreased significantly by the 6th ($P < 0.01$) and 8th ($P < 0.05$) days and glucose values increased by the 8th day ($P < 0.01$). Rectal temperatures increased steadily after the 10th day in the irradiated barrows. (auth)

29941 IMMUNOPATHOLOGY OF MOUSE HEPATITIS VIRUS TYPE 3 INFECTION. II. Effect of Immunosuppression in Resistant Mice. Dupuy, J. M.; Levey-Leblond, E.; Le Prevost, C. (Institut National de la Sante et de la Recherche Medicale, Bicetre, France). J. Immunol.; 114: No. 1, 226-230(Jan 1975).

Normal adult A strain mice are resistant to MHV_3 infection. A strain mice immunosuppressed by 600 rads of x-irradiation or by anti-lymphocyte serum treatment became susceptible to the virus and died with specific lesions of the liver and high virus titers. However, mice immunized with MHV_3 before sublethal x-irradiation resisted a second injection of virus. Resistant adult ($A \times C3H$) F_1 hybrids undergoing graft-vs-host (GVH) reaction became highly susceptible to MHV_3 injected 8 days after parental cell injection. Virus titer 3 days after injection was 2 logs higher in mice undergoing GVH than in controls. However F_1 hybrid mice resisted virus challenge when the first injection of virus was given 2 weeks before GVH induction. In addition, thymectomy also modified the behavior of resistant animals toward virus infection. It appears, therefore, that cell-mediated immune functions play an important role in resistance of mice to MHV_3. (auth)

29942 RADIATION STUDIES IN MICE. Puro, E. A. Toronto; Univ. of Toronto (1970). 87p.

Thesis.

Female mice were exposed to whole-body 250 kVp x rays delivered at dose rates of 105, 11.6, 5.37, and 2.86 R/min. The $LD_{50/30}$ varied as the inverse of the dose rate raised to the power of 0.08. At all dose rates, the greatest mortality occurred between 9 to 30 days after exposure, and the time at which the mice died was independent of the dose rate employed. The effect of dose rate variation upon hemopoietic stem cell sur-

vival as estimated by the ability to form colonies (CFU) was studied. Cells from the femoral marrows of mice were transplanted into irradiated recipient mice, and the transplanted cells were subsequently irradiated within the recipients. Higher dose rates were more efficient in killing cells; however, below dosages of 200 R, there was no apparent effect of dose rate on cell survival. Endogenous spleen colony assays were performed to confirm the transplantation results. The radiosensitivity changes of endogenous CFU with dose rate were substantially the same as those obtained by the transplantation method. The results of the spleen colony experiments suggest a close association between CFU survival and animal lethality. (CA)

29943 EFFECT OF IN VITRO IRRADIATION ON THE SUBSEQUENT GROWTH OF ECTOPIC SPLENIC AUTOIMPLANTS. Tavassoli, M.; Sacks, P. V.; Crosby, W. H. (Scripps Clinic and Research Foundation, La Jolla, CA). Proc. Soc. Exp. Biol. Med.; 148: No. 3, 780-783(Mar 1975).

In vitro irradiation of splenic fragments with doses less than 1500 rads does not prevent subsequent regeneration of splenic autoimplants in splenectomized rats. The relative radioresistance of this regenerative process suggests that splenic regeneration is dependent upon the viability of stromal elements. Once the stroma is reconstituted, it is probably "seeded" by circulating lymphohemopoietic cells to form recognizable splenic tissue. In this respect the process is similar to that seen in regenerating marrow tissue. The relative radioresistance of splenic stroma must be taken into account when irradiation is considered as a therapeutic measure for management of splenic disorders. (auth)

29944 STUDIES ON DIURESIS IN RABBITS FOLLOWING X-RAY IRRADIATION, 1. Influence of X-Ray Dosage and the Portion of the Body on Polyuria. Sato, Y. (Mie Prefectural Univ., Tsu (Japan). School of Medicine). 17: No. 2, 129-132(Sep 1973). (In Japanese).

The influence of x-ray irradiation on urinary output was examined. Doses of 325, 500, 1150, and 2000R respectively were given over the abdomen of rabbits, and in only one dose, 500R, was polyuria seen. Maximum polyuria was obtained 30 to 40 minutes after 500R was given over the head, abdomen, and pelvic limb. Irradiation of 500R with ^{60}Co caused a marked increase of polyuria over that of x-ray. These results suggest that a cause of this polyuria could be that a certain substance developed by x-ray irradiation may stimulate secondarily the anterior pituitary, the adrenal cortex system, or the nervous system. (JA)

29945 TRANSLOCATIONS IN MOUSE SPERMATOGONIA AFTER EXPOSURE TO UNEQUALLY FRACTIONATED DOSES OF X RAYS. van Buul, P. P. W. (Rijksuniversiteit, Leiden). Mutat. Res.; 25: No. 3, 361-365(Dec 1974).

The influence of various x-ray fractionation regimes on translocation induction in mouse spermatogonia was studied. Splitting a single exposure of 600 R into two fractions of 300 R separated by 24 h did not influence the translocation yield. When the dose was given in the unequal fractions 100 R + 500 R and 500 R + 100 R, with the same 24 h between the fractions, the translocation frequency was significantly altered. As a possible explanation of these findings it is assumed that the relatively resistant cells surviving the first fraction of the dose are sensitized toward translocation induction when receiving the second fraction of the dose. (NL)

29946 INCIDENCE OF SEX-CHROMOSOME ANOMALIES FOLLOWING IRRADIATION OF MOUSE SPERMATOGONIA WITH SINGLE OR FRACTIONATED DOSES OF X RAYS. Russell, L. B.; Montgomery, C. S. (Oak Ridge National Lab., TN). Mutat. Res.; 25: No. 3, 367-376(Dec 1974).

Attempts to recover XO offspring resulting from 600 R irradiation of spermatogonia proved negative. X rays were administered either in a single dose or in 100 + 500 R fractions separated by 24 h, and controls were strictly comparable in all respects. Altogether 14016 offspring were scored, including a small group derived from irradiated mature spermatozoa. The breeding scheme allowed phenotypic detection of paternal or maternal sex-chromosome loss, paternal nondisjunction, and certain translocations. All phenotypically exceptional mice were examined cytologically and through breeding tests. Similar tests of the mothers of presumed O/X^p exceptionals revealed that in 9 of 14 cases there was a pre-existing XO condition, indicating the importance of performing such a test. (NL)

29947 PROTECTION OF MOUSE SPERMATOGONIA AGAINST X-RAY INDUCED TRANSLOCATIONS. Bajrakova, A. K.; Pantev, T. P.; Nikolov, I. T.; Bokova, N. V. (Research Inst. of Radiobiology and Radiation Hygiene, Sofia). Mutat. Res.; 25: No. 3, 377-381(Dec 1974).

Adult male mice were exposed to different doses of x rays with or without pre-treatment with Adeturon (S-2-aminoethyl-isothiuronium bromide hydrobromide (AET) adenosine triphosphate). Twelve weeks later, primary spermatocytes were examined cytologically at diakinesis-metaphase I for persisting chromosomal translocations, namely multivalents in the form of rings or chains. Regression analysis of the data obtained, was performed. Adeturon protection of heritable structures in mouse germ cells showed a dose reduction factor of about 2. (NL)

29948 THREE-TIER APPROACH TO MUTAGENICITY SCREENING AND THE CONCEPT OF RADIATION-EQUIVALENT DOSE. Bridges, B. A. (Univ. of Sussex, Brighton, Eng.). Mutat. Res.; 26: No. 4, 335-340(Aug 1974).

From 1st international conference on environmental mutagens; Asilomar, CA (29 Aug 1973).

A three-tier approach to mutagenicity screening is proposed, based on three general principles. The first tier consists of in vitro tests which would be the only tests to which compounds not intended for direct ingestion would be subjected, for example industrial chemicals. Substances intended for ingestion (e.g., food additives and medicines) together with other widespread substances that might be expected to accumulate within the body would, if they give negative results in the first tier tests, be subjected to a second tier of in vivo tests using whole mammals. Substances giving positive results in either of these tests would pass to a third tier of evaluation. Here the object would be to carry out experiments designed to give a quantitative indication of the potential risk to man followed by a risk-benefit assessment. It is suggested that one way of comparing the effect of one agent with that of another might be to express it as a radiation-equivalent dose (in radequiv units). (NL)

29949 INDUCTION OF THYMIDINE- AND IUdR-RESISTANT VARIANTS IN P388 MOUSE LYMPHOMA CELLS BY X RAYS, UV, AND MONO- AND BIFUNCTIONAL ALKYLATING AGENTS. Anderson, D.; Fox, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Mutat. Res.; 25: No. 1, 107-122(Oct 1974).

Dose-response curves for mutation to resistance to 5-iodo-2-deoxyuridine (IUdR) and excess thymidine (TdR) in P388 mouse lymphoma cells have been established after exposure of these cells to six chemical mutagens, uv and ionizing radiations. The dose-response curves for all mutagens in both selective systems show considerable similarities when induced mutation frequencies are plotted against survival. Expression time for both types of variants, $IUdR^r$ and TdR^r, are similar, i.e., maximum frequencies are reached by 48 h and there is no fall in variant frequency at late expression times up to 144 h. Over the range of survival levels studied there appears to be little or no dependence of expression time on dose of mutagen. Some loss of mutants after high doses was observed due to the fact that a significant proportion of both TdR^r and $IUdR^r$ clones were more sensitive to the mutagens than the wild-type population. The similarities in induced dose-response curves for different mutagens suggest that the mutants have a common origin, probably an error in repair, but it seems unlikely that errors in cut and patch repair are responsible. A comparison of spontaneous frequencies of $IUdR^r$ and TdR^r variants suggests that IUdR is mutagenic in P388 cells. (NL)

Invertebrates

29950 DISINFESTATION OF STORED PRODUCTS BY GAMMA IRRADIATION. II. Survival Pattern and Reproductive Potential of the Red Flour Beetle, Tribolium Castaneum Herbst, Exposed to Sub-lethal Doses of Gamma Radiation. Rejesus, R. S.; Lapis, E. B.; Parungao, A. M. (Philippine Atomic Research Center, Quezon City). Proc. Radioisotope Soc. Philipp.; 74-80(1973).

Sublethal or sterilization doses (2, 4, 6, 8, 10 kR) were tested to determine whether it will suppress re-infestation by extraneous Tribolium castaneum population. Complete reproductive suppression was effected by 10 kR when both sexes of irradiated parents were paired. When either irradiated male or female was mated with unirradiated adults, hatchability were 0.98% and 12.45% respectively as compared to 63.10% of the control, and subsequently no adults emerged. The same dose (10 kR) resulted in 31.58% mortality of parents and the remainder survived until the observation was terminated. No adult mortality was observed on doses lower than 10 kR in various pairings of irradiated and unirradiated individuals of either sex during the observation period. (INIS)

29951 INFLUENCE OF ANOXIA DURING GAMMA IRRADIATION ON THE FERTILITY AND COMPETITIVENESS OF THE ADULT MALE CODLING MOTH, LASPEYRESIA POMONELLA (L.). Robinson, A. S. (Canada Agriculture, Summerland, British Columbia). Radiat. Res.; 61: No. 3, 526-534(Mar 1975).

Using male codling moths, Laspeyresia pomonella (L.), dose-response curves for dominant lethality were obtained after irradiation in air and nitrogen. To achieve equivalent male sterility a dose given in air had to be multiplied by a factor of 1.5 when the irradiation was given in nitrogen. From the regression equations doses were calculated (and verified experimentally) which gave equivalent male fertility. With the males irradiated in air there was an increase in fertility with time. This was not found in the nitrogen series. Using equivalent male-sterilizing doses, two parameters, percentage egg hatch and F_1 production, were assessed after competition of the irradiated moths with non-irradiated moths, the percentage egg hatch showed no reduction or difference in the competitiveness of the irradiated males, irrespective of the irradiation atmosphere. However, the percentage reduction in F_1 production was just significantly greater when the moths had been irradiated in nitrogen as compared to air. (auth)

29952 BLOOD PROTEIN METABOLISM IN THE LARVAE OF PHORACANTHA SEMIPUNCTATA (COLEOPTER CERAMBYCIDE XYLOPHAGE) AND MODIFICATIONS DUE TO COBALT-60 IONIZING RADIATIONS. Chararas, M. C.; Boulard, C.; M'Sadda, K. (Institut National Agronomique, 75 - Paris (France)). Compt. Rend., Ser. D; 278: No. 24, 3119-3122(10 Jun 1974). (In French).

The biology and nutrition of Phoracantha semipunctata having been studied in previous work, this research is devoted to a comparison of blood lymph protein variations in larvae subjected to irradiations of 10,000 to 100,000 rads and non-irradiated larvae. It is shown that these variations, which depend on the radiation doses and the post-irradiation times, correspond to profound disturbances in the metabolism of the insect. (FR)

29953 INVESTIGATIONS ON RADIOSENSITIVE AND RADIORESISTANT POPULATIONS OF DROSOPHILA MELANOGASTER. V. Relations Between the Relative Radioresistance and Some Recombination Properties in the Irradiated Population ROE I. Noethel, H. (Freie Univ., Berlin). Mutat. Res.; 25: No. 3, 325-336(Dec 1974).

Experiments were conducted to inquire whether the radioresistance observed in an irradiated laboratory population (RÖI) of Drosophila melanogaster might be associated in some way with recombinational processes. Simultaneously, data were collected on the stage distribution of radioresistance on RÖI by studying the induction of dominant lethals and X- chromosome losses in mature females at various exposure levels of x irradiation (in eggs sampled from subsequent 12-h broods). The data show that (1) the radiation response of both populations (RÖI and its control + K) is equal in the highly sensitive mature stages, (2) RÖI is resistant relative to +K in the medium- sensitive stage-7 and younger oocytes collected on days 1.0 to 5.5 after exposure, and (3) the difference between the population disappears again when the sensitivity steeply decreases on days 5.5 to 6.5. Similar brood-pattern experiments indicate that exchanges between homologous chromosomes are induced (by temperature shock or x irradiation) in eggs sampled after day 5.5. Thus it is evident that the relative radioresistance in RÖI is due to mechanisms which operate in the developing oocyte in the stages of a medium radiosensitivity between that phase in which recombination is inducible and stage-14. The observed temporal sequence of recombination and relative radioresistance in RÖI supports the speculation that the latter might be associated with recombination repair. However, the natural recombination frequencies were equal in + K and RÖI. Likewise, no clear evidence was obtained on differences between the two populations with respect to x-ray-induced modifications of homologous exchanges in various para- and pericentric parts of the genome. (NL)

29954 MODEL TO EXPLAIN THE RESPONSE OF STAGE 7 OOCYTES OF DROSOPHILA TO THE INDUCTION OF DOMINANT LETHALS UNDER CONDITIONS OF EXPOSURE-PROTRACTION AND FRACTIONATION. Volkers, W. S. (Rijksuniversiteit, Leiden). Mutat. Res.; 25: No. 1, 47-51(Oct 1974).

A model is presented, analyzing the effect of different irradiation procedures on the yield of dominant lethals in oocytes of Drosophila. The data employed in the analyses confirm the conclusion that for small time durations, exposure fractionation is more efficient than exposure protraction in reducing dominant lethal damage whereas with longer time durations, the reverse is true. (NL)

29955 EFFECT OF GAMMA RAYS ON THE LARVAE OF PLODIA INTERPUNCTELLA (LEPIDOPTERA: PHYCITIDAE). Bagheri-Zonouz. (Univ. of Teheran). Entomol. Exp. Appl.; 17: No. 2, 215-218(1974). (In French).

Protection of stored products such as pistachio nuts, walnuts, almonds, and shelled hazel nuts against damage from infestation by larvae and adults of Plodia interpunctella (Lepidoptera: Phycitidae) by irradiating these products with appropriate doses of gamma rays, were studied. The tests show that doses of 10 krad applied to last-stage larvae prolong the length of pupal life, reduce the percentage of imaginal emergence and cause regression of the female ovaries. These effects are even more pronounced with doses of 12 and 14 krad. This last dose may well deserve the most attention. (NL)

29956 STUDIES ON THE STERILE MALE TECHNIQUE AS MEANS OF CONTROL OF ADOXOPHYES ORANA (LEPIDOPT., TORTRICIDAE). III. An Evaluation of Competitiveness of Laboratory-Reared Moths. Delinger, D. L.; Ankersmit, G. W. (Landbouwhogeschool, Wageningen, Netherlands). Neth. J. Plant Pathol.; 79: No. 6, 229-235(1973).

Mating compatitiveness of an inbred irradiated, mass reared strain of Adoxophyes was approximately half that of males collected as nearly fullgrown larvae or pupae in the field. This reduction was not caused by irradiation effects. No indications of genetic inferiority of the laboratory strain were found since the difference in competitiveness disappeared after wild moths were reared for one generation on artificial diet. A diet effect on competitiveness seems most likely. (NL)

29957 GAMMA RADIATION AND INSEMINATION IN THE CODLING MOTH, LASPEYRESIA POMONELLA (LEPIDOPTERA: OLETHREUTIDAE). Robinson, A. S. (Agriculture Canada, Summerland, British Columbia). Entomol. Exp. Appl.; 17: No. 3, 425-432(1974).

Irradiated and nonirradiated male codling moths did not differ in their ability to transfer spermatophores when caged with nonirradiated females. However, irradiation significantly reduced the inseminating ability of the treated males as determined by the presence of sperm in the spermathecae of the females. The females inseminated by the irradiated males oviposited significantly fewer eggs than the females inseminated by the nonirradiated males. No differences were found in the quantity of sperm present in the spermathecae. The length of the period of time between irradiation and mating (the post-irradiation period) did not affect the insemination rate but the percentage egg hatchability did show an increase with the length of this period. (NL)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 29598, 29599, 29601, 29608, 29649, 29650, 29653, 29863, 29864, 29869, 29901, 29909, 29911, and 30360.

29958 (ERDA-Tr-21) DETERMINATION OF DOSE EQUIVALENT IN THE CASE OF INTERNAL CONTAMINATION WITH TRITIATED WATER. Kollar, J.; Merjavy, S. Translated from Jad. Energ.; 19: No. 7, 220-226(1973). 22p. Dep. NTIS $4.25.

Current methods for determination of tritium in the organism are based on measurement of tritium concentrations in body liquids (urine, exhaled vapor, saliva, sweat, etc.). Precise determination of tritium in the human body is possible if the measurement is made sooner than several weeks after contamination, and requires the knowledge of individual biological half life. In routine surveys the determination of the dose equivalent is based on periodical measurement of tritium concentrations in urine and the time of the intake event is assumed. The accuracy depends on the time interval between two consecutive measurements and on individual half-life of tritium excretion. In case of repeated tritium intake the reliability of the dose equivalent evaluation also depends on the ratio between tritium concentrations in two consecutive measurements. The tabulated values make it very simple to determine the limits and the average value of the dose equivalent received by the critical organ during chronic exposure. (auth)

29959 (UCRL-76571) BIOLOGICAL HAZARD AND MEASUREMENT OF PLUTONIUM. Myers, D. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Feb 1975. 43p. (CONF-7410106-1). Dep. NTIS $5.25.

From radiological defense officer's conference; Lake Tahoe, California, USA (23 Oct 1974).

The basic characteristics of plutonium, including its uses, its physical and chemical properties, and the types and amounts of radiation it emits are reviewed. The biological effects associated with exposure to plutonium are discussed with emphasis on ^{238}Pu, ^{239}Pu, and ^{240}Pu. It is pointed out that the amount of Pu in the national inventory is going to increase significantly in the next few years, particularly if the breeder reactors become a reality. Except for criticality accidents, Pu is essentially an internal

radiation hazard. From the standpoint of the quantity of the radioisotope in the national inventory, the potential sources of dispersal, environmental persistence, and MPC, ^{239}Pu is among the most hazardous of radionuclides. The most likely and most hazardous route of entry into the body is via inhalation. The present maximum permissible lung burden for PuO_2 is 16 nCi (0.25 μg). There is some controversy as to whether this is a safe amount or not, primarily because of the hot particle problem. Based on animal experiments, large exposures to PuO_2 can lead to lung inflammation, fibrosis of the lungs, and lung cancer. There have been several incidents involving Pu, and a number of individuals have been exposed to amounts exceeding maximum permissible lung and body burdens. However, to date, none of these individuals have shown any significant effects attributed to the Pu. The most useful instrument for measuring Pu contamination in the field is the FIDLER detector. Basically, it is a 12.5-cm-diameter, 0.15-cm-thick NaI crystal designed to measure the low-energy x rays and γ rays from Pu. It has a sensitivity of a few $\mu g/m^2$ for ^{239}Pu. (auth)

29960 GENETICALLY SIGNIFICANT DOSE FROM RADIONUCLIDE INVESTIGATION IN JAPAN, 1971. Hashizume, T.; Kato, Y.; Maruyama, T.; Kumamoto, Y.; Nishimura, A. (National Inst. of Radiological Sciences, Chiba (Japan)). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 10, 818-820(Oct 1973). (In Japanese).

The genetically significant dose from radiopharmaceuticals in nuclear medicine was estimated on a 1971 national wide survey of randomly sampled hospitals and clinics. The annual number of examinations were about 1.7×10^5. The gonadal doses, millirad per microcurie of a given radionuclides administered, were estimated using the values of ICRP Publication 17. The genetically significant doses were 0.36 and 0.11 millirad per person per year for male and female, respectively and 0.47 millirad per person per year in total. (auth)

Animals

Refer also to abstract 29979.

29961 (TID-26722) RADIOACTIVITY OF AQUATIC ENVIRONMENT. Kolehmainen, S. E. (Puerto Rico Nuclear Center, Mayaguez). 1975. 28p. (In Spanish). Dep. NTIS $4.50.

Radioactivity in the aquatic environment is produced by natural and man-made radionuclides. Artificial radionuclides enter fresh and marine waters as fallout from nuclear bomb tests, the processing of nuclear fuel, nuclear power plants, nuclear powered vessels, and isotope laboratories. The radioactivity of artificial radionuclides in the environment at the present time is less than 1% of that of natural radionuclides. Aquatic organisms are exposed to radiation from their surroundings, water, sediments, and air, and from the radionuclides in their tissues. The dose from man-made radionuclides varies greatly between different aquatic environments, depending on the closeness to the sources of artificial radionuclides, and the physical, chemical, and biological behavior of the radionuclides in the particular body of water. Radionuclides in water are subject to dilution, dispersion, precipitation, sorption, and biological uptake. Depending on the physical, chemical, and physiological properties of the element, the radionuclides of this element can be removed from water or can be efficiently accumulated by aquatic organisms. Different factors determining the levels of artificial radionuclides in aquatic organisms and food chains are discussed. Radiation effects, both acute and chronic, are discussed in relation to the somatic and genetic damage. No documented cases indicate that radiation has been responsible for changing the whole gene pool of a population of aquatic organisms. Natural selection tends to eliminate genetic anomalies caused by ionizing radiation. International and national regulations in radiation protection, and methods for predicting hazards from the releases of radioactivity to the aquatic environment are discussed. (auth)

29962 (UCRL-76558) TRITIUM TOXICITY: INCREASED RELATIVE BIOLOGICAL EFFECTIVENESS OF ^3HOH WITH PROTRACTION OF EXPOSURE. Dobson, R. L.; Arrington, J. H.; Kwan, T. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Mar 1975. 20p. (CONF-750503-1). Dep. NTIS $4.00.

From 4th national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

Main concern with environmental tritium from nuclear energy operations is with low ^3HOH concentrations and chronic exposure. Since tritium's relative biological effectiveness (RBE) has been found to be elevated at low doses, comparisons of protracted with short-term exposures take on added importance in evaluating biological hazard. Weanling mice were exposed to ^3HOH in body water at 20 μCi/ml for 5 days, receiving β radiation to cells at 5.2 rads/day. Surviving primary oocytes were counted microscopically in ovaries and compared to controls; survival was 43%. For comparison, other weanlings were exposed to ^{60}Co γ irradiation at 5.9 rads/day. Oocyte survival was again 43%. Comparison of the dose-responses indicated an RBE for tritium of 1.1. This contrasts with 1.7 found previously in 14-day-old mice given continuous, protracted exposure from conception. The lower RBE may be due to the higher dose-rates used. Experimental and theoretical evidence questions this, however. Alternatively, the higher RBE with protracted exposure (at the same total dose) may reflect more effective microdistribution of tritium atoms within cells from the longer time available for exchange and incorporation into strategic sites. Most importantly, however, regardless of mechanisms responsible (which are under study), these results show that ^3HOH becomes more damaging compared to γ rays when low-level exposure is protracted. This has special significance from the standpoint of environmental and health protection. (auth)

29963 EFFECT OF ^{90}Y INHALED IN FUSED CLAY PARTICLES ON THE GASTROINTESTIONAL TRACT OF BEAGLES. Hahn, F. F.; Barnes, J. E.; Hobbs, C. H.; Mauderly, J. L. (Lovelace Foundation, Albuquerque, NM). Radiat. Res.; 61: No. 3, 444-456(Mar 1975).

Ten beagles were exposed by inhalation to aerosols of ^{90}Y in fused clay particles to study the radiation dose to the gastrointestinal (GI) tract and effects resulting from clearance of the upper respiratory tract after the deposition of high initial body burdens of inhaled ^{90}Y. Focal colonic lesions were found in two dogs, 8 and 12 days after inhalation of ^{90}Y that resulted in GI burdens (GIB) of 18 and 34 mCi. Similar, but less severe, lesions were found in two dogs sacrificed 27 days after exposure with GIBs of 18 and 32 mCi. No GI lesions were found in six dogs with GIBs of 9 to 18 mCi. Two of the 10 dogs had thermoluminescent dosimeters surgically implanted in the GI tract lumen and submucosa. The highest radiation doses were measured in the colon. One dog, with measured doses to the colon of 3200 to 5700 rads, had focal colitis when sacrificed 8 days after exposure. The other dog, with doses to colon of 1000 to 2800 rads had no GI lesions at sacrifice 8 days after exposure. Although focal colitis was found, no dogs died due primarily to GI injury. Other significant findings were nasal dermatitis and radiation pneumonitis. The latter was more severe and life threatening than the GI injury. (auth)

29964 HISTOLOGICAL EXAMINATION OF THE KIDNEYS OF RABBITS TREATED WITH RADIOACTIVE MERCURIAL COMPOUNDS. Unger, E.; Vandor, F.; Nemeth, G. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest (Hungary); Magyar Tudomanyos Akademia, Budapest. Orvosradiologiai Kutato Csoport). Strahlentherapie; 148: No. 4, 386-393(Oct 1974). (In German).

Mercury-203-labeled Neohydrin and $^{203}HgCl_2$ administered parenterally to rabbits at an activity level of 13 μCi per animal will after 3 days to 1 year give rise to moderate tubular degeneration and glomerular changes in the kidneys without causing any severe irreversible renal lesions. (auth)

29965 DOSE AND GERM CELL STAGE DEPENDENCE OF STRONTIUM-89 MUTAGENIC EFFECTS IN RAT MALES. Bairakova, A. K. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). Strahlentherapie; 148: No. 4, 394-396(Oct 1974).

Adult male rats were given a single intraperitoneal strontium-89 dose—0.5, 1.5, or 2.0 μCi/g body weight. The genetic damage was measured by the prenatal death rate in F_1 derived from 1 to 3 week and 11 to 13 week conceptions following paternal irradiation. Significant increase in postimplantation mortality was only found for 1.5 μCi/g. This mutagenic effect was similar in extent in the treatment of premeiotic or postmeiotic stages. The possibility is discussed of a comparative study of radiosensitivity in germ cells depending on the stage of spermatogenesis following internal exposure to radiation. (auth)

29966 RADIOTHERAPEUTIC EFFECT OF NAPHTIDONE-^3H FOR MELANOMAS. Bobrova, V. N.; Gavrilenko, I. S.; Ivanov, I. I.; Shestakov, A. D. (Inst. of Radium, Leningrad). Vop. Onkol.; 21: No. 1, 52-57(1975). (In Russian).

Under study was the inclusion of naphtidone-^3H (syncavite) in the dosage of 6 mG/mouse in intraperitoneal injection in mice with Garding-Passey melanoma. During an early period after the injection, no selective localization of tritium in the tumor was observed, on the second day a correlation of the tritium inclusion is changed in favor of predomination of radioactivity in tumors on account of elimination of the marker from other organs and tissues. The maximum inclusion of tritiated naphtidone-^3H in pigment cells and stroma of the tumor was observed during the

period from 4 to 24 hours after its administration with a predominant localization in melanocytes. Naphtidone-^{3}H in a dose of 40 mCi per mouse induced a suppression of melanoma growth by 49% on the average. A reduction of the dose twice as that practically did not lessen an antitumor effect. The combined effect of naphtidone-^{3}H and cyclophosphane on Garding-Passey melanoma resulted in summation of the antitumor effect, the percentage of suppression of the tumor growth reached 80%, no significant changes being noted in the content of peripheral blood of tumor-bearing animals. (auth)

29967 TUMORS OF SOFT TISSUES AND INTERNAL ORGANS INDUCED BY NEPTUNIUM-237. Levdik, T. I.; Buldakov, L. A. Vop. Onkol.; 22: No. 1, 80-87(1975). (In Russian).

A dependence between the appearance of tumors of soft tissues and organs in rats on a dosage of the osteotropic α-radiator Np-237 is analyzed. An accumulation of the absorbed dose over 100 rad in the skeleton with a decrease of an average survival in the background leads to more frequent neoplasia of soft tissues and organs and the appearance of the latter in earlier terms than in the control, that is a manifestation of accelerated ageing processes. As a result of chronic and single neptunium administration in the organism, leucoses, malignant tumors of the liver and kidney may appear more frequently. The shortest latent period is typical for leucoses development. (auth)

29968 RESPONSE OF PREIMPLANTATION MOUSE EMBRYOS EXPOSED TO ^{90}Sr-^{90}Y EQUILIBRIUM MIXTURE IN VITRO. Jacobsen, F. L. Ithaca, NY; Cornell Univ. (1974). 150p. University Microfilms Order No. 75-6737.

Thesis (Ph. D.).

A study was undertaken to investigate the response of preimplantation mouse embryos to strontium-90 and related beta emitting radionuclides. The first part was a determination of absorbed doses and dose rates for embryo culture media containing either ^{90}Sr-^{90}Y, ^{89}Sr, or ^{45}Ca using miniature LiF-teflon thermoluminescent dosimeters. The second part considered the effects on development to the blastocyst stage of two-cell embryos exposed to chronic ^{90}Sr-^{90}Y, ^{89}Sr, or ^{45}Ca radiation in vitro during a period of 72 hours. The third part examined preimplantation embryo development after fertilization by sperm from male mice injected intraperitoneally with 30.6 μCi of ^{90}Sr-^{90}Y equilibrium mixture. The absorbed doses and dose rates from the embryo culture media containing either ^{90}Sr-^{90}Y, ^{89}Sr, or ^{45}Ca were determined by miniature LiF-teflon thermoluminescent dosimeters placed directly into the radioactive culture medium. The dosimeters were found to be sufficiently sensitive to beta radiation at the dose levels employed in this study to give reproducible dose measurements, provided calibrated first with a source containing the radionuclide to be measured. Predictive linear regression equations were calculated for each of the radionuclides relating the measured dose in rads to the embryos as a function of increasing specific activity in μCi/ml of the culture medium. The response of preimplantation mouse embryos was studied by exposing two-cell embryos to chronic beta radiation in culture for 72 hours in vitro in media containing either ^{90}Sr-^{90}Y, ^{89}Sr, or ^{45}Ca and scored for the endpoint of development to the expanded blastocyst stage. A similar dose-response pattern of decline in embryo development as a function of increasing radiation dose was observed for the three radionuclides when cultured under identical conditions. Linear regression equations were calculated for the three radionuclides to describe the best-fit line relating the percentage embryo survival to the expanded blastocyst stage as a function of increasing absorbed dose. These equations were then used to determine the dose that would produce a 50 percent embryo survival. A dose of 237 rads was obtained for 50 percent survival of embryos exposed to ^{90}Sr-^{90}Y incorporated into Whitten culture medium over the 72 hour culture period. However, the doses to produce a 50 percent survival of embryos cultured in ^{90}Sr-^{90}Y, ^{89}Sr, and ^{45}Ca incorporated into Brinster medium were considerably lower than the value obtained for ^{90}Sr-^{90}Y incorporated in Whitten medium. (Diss. Abstr. Int., B)

Microorganisms

29969 EFFECTS OF DISINTEGRATION OF INCORPORATED ^{35}S ON MUTATION FREQUENCY. Najer, A.; Jaguztyn-Krynicka, K. (Univ., Warsaw). Acta Microbiol. Pol., Ser. B; 7: No. 1, 33-36(1975).

The reverse mutation to the wild type of λ sus 9 and T4 am B17 bacteriophages, grown in bacteria prelabeled with ^{35}S and stored at -196°, was studied. No mutagenic effect of ^{35}S was observed in both λ and T4 bacteriophages. It is suggested that there is no influence of ^{35}S disintegrations on the properties of DNA polymerase to which the mutagenic activity could be attributed. (auth)

29970 COMPARISON OF THE MUTAGENIC EFFECTS OF ^{35}S DECAY IN ESCHERICHIA COLI STRAINS WP-2 AND WP-2S. Pluciennik, H.; Kanski, R. (Univ., Warsaw). Acta Microbiol. Pol., Ser. B; 7: No. 1, 37-40(1975).

Comparison was made of the lethal and mutagenic efficiency of ^{35}S → ^{35}Cl transmutation of incorporated ^{35}S in cells of Escherichia coli strain WP-2 and WP-2S (UV-sensitive). Bacteria were stored at -196°. ^{35}S → ^{35}Cl transmutation induced a higher lethal effect in strain WP-2 than in the UV-sensitive strain WP-2S. Reversions try^{-} → try^{+} were induced with an approximately similar efficiency in both strains compared. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 29603, 30057, and 30073.

29971 EFFECTS OF ADMINISTRATION OF ESTROGEN OR DIPHENYLHYDANTOIN ON THE KINETICS OF DIPHENYLHYDANTOIN IN MAN. Fernandez-Pol, J. A.; Zaninovich, A. A. (Univ., Buenos Aires). J. Nucl. Med.; 16: No. 4, 305-308(Apr 1975).

The rate of disappearance of ^{131}I-diphenylhydantoin (^{131}I-DPH) from plasma and its hepatic uptake were studied during a control period and after estrogen administration in ten normal human subjects. Four subjects were given DPH and were studied in the same fashion as the estrogen-treated group. After intravenous injection of a tracer dose of ^{131}I-DPH (period of study: 30 to 150 min after ^{131}I-DPH administration), the estrogen-treated group showed an increase in the plasma half-time, a decrease in the fractional turnover rate, and a decrease in the distribution space of ^{131}I-DPH in comparison with control. The hepatic uptake was decreased in comparison with the control, which may be explained by an increase in the binding capacity of thyroxine-binding globulin (TBG) induced by estrogens. An increase in the distribution space of ^{131}I-DPH was observed in subjects treated with diphenylhydantoin. Consequently, the clearance rate was increased. No change in half-time or in turnover rate was observed. The hepatic uptake in the DPH-treated group was increased in comparison with control. This may be explained by a displacement of ^{131}I-DPH by DPH from the binding sites of TBG. This study showed, therefore, that changes in the binding capacity of TBG are associated with alterations in the peripheral metabolism of ^{131}I-DPH in man. (auth)

29972 STUDIES ON ENVIRONMENTAL CONTAMINATION BY URANIUM, 5. Uranium Contents in Daily Diet and in Human Urine from Several Populations Around a Uranium Mine in Okayama Prefecture. Yamamoto, T.; Yunoki, E.; Yamakawa, M.; Shimizu, M. (Hygienic Lab. of Okayama Prefecture (Japan)); Nukada, K. J. Radiat. Res.; 15: No. 3, 156-162(Sep 1974).

Uranium contents of daily diets and of human urine were examined from inhabitants around a uranium mine and its refinery (Ten-no and Nakatsugo hamlets, Kamisaibara Village, Okayama Pref.). Those from Ukainishi and Tomiyoshi area (Mitsu and Tsudaka Town, Okayama Pref.) served as controls. The daily diet and human urine were randomly collected in each area. Uranium was assayed by solid fluorimetry after ashing. The uranium content means in diet from Ten-no and Nakatsugo were 4.55 and 2.86 μg/day/person, respectively, while the means from control areas were 1.02 (Ukainishi) and 0.86 (Tomiyoshi) μg/day/person. Urinary uranium levels from Ten-no and Nakatsugo were 0.14 and 0.07 μg/day/person, respectively, while it was 0.01 μg/day/person in both control areas. No seasonal variations were observed in either dietary or urinary uranium in the two test areas nor in those of control areas. (auth)

Animals

Refer also to abstracts 29624, 29627, 29628, 29630, 29912, 29922, 29929, 29963, and 29968.

29973 ACCUMULATION OF ^{65}Zn AND OTHER RADIONUCLIDES BY TUBIFICID WORMS. Dean, J. M. (Battelle Pacific Northwest Labs., Richland, WA). Hydrobiologia; 45: No. 1, 33-38(Jul 1974).

Freshwater Tubificidae were exposed to zinc-65 in water and on sediments. The worms readily accumulated the radionuclides from water but did not accumulate measurable amouts of the radionuclides that were bound to sediments. (NL)

29974 ROLE OF HOMEOSTASIS IN ANIMAL RADIORESISTANCE. Graevskaya, B. M.; Nechaev, I. A.; Zolotareva, N. N.

(Inst. of Evolutionary Morphology and Ecology of Animals, Moscow). Zh. Obshch. Biol.; 36: No. 1, 135-141(1975). (In Russian).

The greater the ability of the organisms to mobilize the homeostasis-responsible functions, the easier it resists the effect of radiation damage. The above phenomenon is associated with the favorable indices of the mean level showing the adequate condition of its regulatory mechanisms. (auth)

29975 POSSIBILITY OF RADIOIODATE APPLICATION IN ANIMAL ORGANISMS. Mraz, L.; Stollarova, N.; Paladi, Sh. Isotopenpraxis; 11: No. 2, 66-67(Feb 1975). (In Russian).

The behavior of carrier free $^{131}IO_3^-$ in blood and blood serum of rats in vitro and in vivo was followed. The unstability of radioiodate and its rapid reduction to ^{131}I was verified. Detection was carried out radiochromatographically on thin layer Silufol UV 254. Our results confirm the absence of radioiodate immediately after its application in vitro and in vivo in micromolecular structures in serum fractions after the protein agglutination. (auth)

29976 REMOVAL FROM THE RAT OF INTERNALLY DEPOSITED ^{241}Am BY LONG-TERM TREATMENT WITH Ca AND ZnDTPA. Seidel, A. (Kernforschungszentrum, Karlsruhe, Ger.). Radiat. Res.; 61: No. 3, 478-487(Mar 1975).

The removal from the rat of intravenously injected ^{241}Am by repeated administration of Ca- or ZnDTPA was studied. With a prompt treatment, the efficacy of ZnDTPA is lower than that of CaDTPA, whereas delayed therapy yields identical results for both chelates. DTPA efficacy diminishes in the course of chronic treatment, and the loss in the effect due to delayed initiation of the treatment cannot be compensated for by an increase in the total cumulative dose of DTPA. After intramuscular administration of ^{241}Am prompt DTPA treatment is highly effective as it enhances the absorption of ^{241}Am and prevents the build-up of a systemic body burden. The practical implications of the results are discussed. (auth)

29977 EFFECT OF GROWTH RATE AND SIMIAN ADENOVIRUS-7 TRANSFORMATION ON IN VITRO ^{67}Ga BINDING TO HAMSTER EMBRYO CELLS. Gams, R. A.; Long, W. K.; Alford, C. A.; Glickson, J. D. (Univ. of Alabama, Birmingham). J. Nucl. Med.; 16: No. 3, 231-233(Mar 1975).

The influence of growth rate and malignant transformation on ^{67}Ga uptake was studied using cultured hamster embryo fibroblasts. Normal nonconfluent cells in log phase of growth bound approximately twice as much isotope as did confluent cells in a plateau phase of growth. In contrast, cells transformed by simian adenovirus-7 (SA-7), which were also undergoing log growth, bound almost no ^{67}Ga. These results suggest that, although the rate of cellular proliferation may influence tissue affinity for ^{67}Ga, other factors must also be considered when studying the effect of malignant transformation. (auth)

29978 ANALYSIS OF THE RETENTION OF PLUTONIUM BY THE TISSUES OF THE RAT. Hollins, J. G.; Storr, M. C. (National Research Council of Canada, Ottawa). Radiat. Res.; 61: No. 3, 468-477(Mar 1975).

The amount of ^{239}Pu in the blood, six bones, the kidneys, and the liver of male rats was measured at 18 different intervals of time between 5 min and 1 yr after a single intravenous injection of 0.1 μCi ^{239}Pu/kg rat as plutonium citrate. The data collected have been used to obtain models for the retention of plutonium by an organ. The rate of transfer of plutonium from blood to bone was found to depend simply on the amount of plutonium in the blood, but the rate of transfer of plutonium from blood to the soft organs involved plutonium in three species, each species being transferred at a characteristic rate that led to a triphasic exponential equation for the retention of plutonium by blood. (auth)

29979 CORTISOL METABOLISM IN SKIN OF BEAGLES BEARING ^{241}Am. Nabors, C. J. Jr.; Hinckley, J. S. (Univ. of Utah, Salt Lake City). Radiat. Res.; 61: No. 3, 513-518(Mar 1975).

Skin from beagles bearing ^{241}Am with and without tumors and from controls was studied. The metabolism of [4-^{14}C] cortisol was significantly elevated over controls in both ^{241}Am-injected groups. This metabolic alteration may indicate a radiation-induced change in cortisol metabolism by skin from ^{241}Am-injected beagles. (auth)

29980 METABOLISM OF ^{60}Co IN CHICKENS: RETENTION AND DISTRIBUTION. Salminen, K. (Univ., Munich). Comp. Biochem. Physiol.; 50: No. 1B, 113-117(1975).

The retention and distribution of ^{60}Co in chickens was studied for up to 46 days following the administration of a single peroral 800 or 400 nCi/kg $^{60}CoCl_2$ dose. The absorption of ^{60}Co was found to be low. After 5 days over 97% of the administered radioactivity had been excreted. The retention of ^{60}Co in organs and tissues can adequately be described by a power function of the form $R(t) = a \cdot t^{-b}$ in which R(t) gives the retention after time (t) (days). The numerical values of a and b were determined for the organs and tissues of chickens. The fractional distribution of ^{60}Co in chickens was found to vary at various time intervals after the administration. High initial fractional distribution was recorded in the intestine, liver, and kidneys. Low initial but steadily increasing fractional distribution was noted for musculature and skeleton. (auth)

29981 GROWTH, FERTILITY, AND TISSUE STUDIES OF MICE FED RADIOLYTIC PRODUCTS ARISING FROM GAMMA IRRADIATED BEEF FAT. Mafarachisi, B. A. Amherst, MA; Univ. of Massachusetts (1974). 141p. University Microfilms Order No. 75-6051.

Thesis (Ph. D.).

Evaluation of 26 radiolytic compounds (RC's) previously identified both qualitatively and quantitatively from various sources of fat irradiated at 6 megarads was done. The actual concentrations of the RC's were based on the yields from beef club steak fat. Three consecutive generations of albino mice were fed ad libitum the control Diets 1 and 2, and 5 experimental diets containing the RC's in combinations of 26, 9, 9 and 8 at 1000× concentration, and one diet with 26 RC's at 333× concentration after irradiation at 6 megarads. These experimental diets were assigned numbers 3, 4, 5, 6 and 7, respectively. The following parameters were used as indexes of toxicity at weaning: fertility, body weight, survival rate, gross and histopathological examination of organs and organ tissues, differential cell counts and hematocrits and hemoglobin (Experiment II only). The following results of the third generation weanlings were obtained. In nearly all these parameters, Diet 3 and 4 mice performed poorly. Growth was depressed 22% (Diet 3) and 10% (Diet 4). Survival rate depression was 45% (Diet 3) and 28% (Diet 4). Because of this poor performance, a second experiment was designed to observe the effect of these RC's further. Diet 4 RC's were divided into 4 groups with 2 RC's each and one with 3 RC's, at the factors of 4500×, 3000×, 1000× and 100× the level of RC's at 6 megarads. The mice on the diet at 3000× level and containing 1-tridecene, 1-tetradecene and 1-heptadecene, showed depression of fertility 67% (First generation) and 91% (Second generation). The survival rate in the same group was depressed 50% (First generation) and 100% (Second generation). Some of the female mice that were fertile showed an unusual lack of interest in their pups. The group of mice on 100× RC's performed as well as the control mice. (Diss. Abstr. Int., B)

29982 COMPARTMENTAL ANALYSIS OF THE METABOLISM OF $^{63}Ni(II)$ IN RATS AND RABBITS. Onkelink, C. (Univ. of Connecticut, Storrs); Becker, J.; Sunderman, F. W. Jr. Contract AT-(11-1)-3140. Res. Commun. Chem. Pathol. Pharmacol.; 6: No. 2, 663-676(Sep 1973).

The kinetics of $^{63}Ni(II)$ metabolism was studied in rats and rabbits following a single intravenous injection of $^{63}NiCl_2$. In both species, $^{63}Ni(II)$ was rapidly cleared from plasma or serum during the first 2 days after the injection, and it disappeared at a much slower rate from 3 to 7 days. Urinary excretion of $^{63}Ni(II)$ averaged 78% of the administered dose during the first day after the injection in rabbits, and 78% of the dose during 3 days after the injection in rats. Measurements of $^{63}Ni(II)$ distribution and excretion in both species suggest that $^{63}Ni(II)$ is diluted within a volume composed of 2 compartments, and that $^{63}Ni(II)$ is eliminated by first-order kinetics. A mathematical model is proposed which permits the description of $^{63}Ni(II)$ metabolism in quantitative terms. The parameters of the model (compartmental volumes and clearances) are reported for the two species. The two-compartment model was tested and verified by its ability correctly to predict concentrations of $^{63}Ni(II)$ in serum or plasma of animals which received continuous infusions or repeated daily injections of $^{63}NiCl_2$. (auth)

29983 DISTRIBUTION OF ^{67}Ga FOLLOWING INTRAVENOUS ADMINISTRATION: EFFECTS OF DISODIUM EDETATE THERAPY. Hurwitz, S. R.; Hagan, P. L.; Alazraki, N. P. (Univ. of California, San Diego, La Jolla). J. Nucl. Med.; 16: No. 4, 280-283(Apr 1975).

Following intravenous administration of ^{67}Ga-citrate to normal and abscessed rats, the colon content of ^{67}Ga decreased with increasing oral doses of Na_2EDTA. The effects observed, however, were not thought to be of potential clinical value. (auth)

29984 EFFECTS OF 3-METHYLINDOLE ON HEMOLYSIS, TRANSPORT OF $^{22}Na^+$, AND ATPASE ACTIVITIES OF BOVINE ERYTHROCYTES. Bray, T. M.; Carlson, J. R. (Washington State Univ., Pullman). Proc. Soc. Exp. Biol. Med.; 148: No. 3, 875-879(Mar 1975).

Biochemical effects of 3MI on cellular membranes were investigated. This study was conducted to examine the effects of

3MI on the hemolysis of erythrocytes, the transport of $^{22}Na^+$ in resealed erythrocyte ghosts, and on the ATPase activities of erythrocyte membranes. The percent of hemolysis as a function of 3MI incubation time was sigmoidal. Seventy-five percent of the hemoglobin was released with the second 2 hr of incubation during which the concentration of 3MI in the cells reached a plateau of 2500 μg/ml of packed RBC. The effect of 3MI at a subhemolytic concentration on passive and active $^{22}Na^+$ transport were not significant. The total and Mg^{2+}-dependent ATPase activities in the membranes were significantly increased after 1 hr of incubation with 3MI at concentrations of 100, 200, 300, 400 and 500 μg/ml ($P \leq 0.02$). (auth)

Plants

Refer also to abstract 29848.

29985 (DP-MS-74-63) ABSORPTION OF TRITIATED WATER VAPOR FROM THE ATMOSPHERE BY THE NEEDLES OF PINE TREES. Murphy, C. E. Jr.; Corey, J. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jan 1974. Contract AT(07-2)-1. 14p. (CONF-750503-2). Dep. NTIS $4.00.

From fourth national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

One means of tritium absorption into an ecosystem is the diffusion of tritiated water vapor into tree needles where it becomes part of the plant water supply. The mechanisms by which absorption of tritiated water vapor takes place were studied with two slash pine trees: Pinus elliotii Engelm. Three branches on each tree were enclosed in clear plastic bags, and three branches on each tree were enclosed in double, dark green bags, and 40 ml of water containing 15.7×10^3 pCi/ml of tritium was placed in the bottom of each bag. The foliage was not exposed directly to the water, so that all absorption would take place in the vapor phase. An analysis of the uptake rates indicates that tritiated water vapor diffuses into the foliage by the same pathways as water vapor diffuses out of the foliage. (auth)

29986 CARBON-14 ASSIMILATE TRANSLOCATION IN NODULATED AND NONNODULATED SOYBEANS. Russell, W. J. Columbia, MO; Univ. of Missouri (1974). 73p. University Microfilms Order No. 75-5792.

Thesis (Ph. D.).

Experiments consisted of exposing nodulated plants to $^{14}CO_2$ at four times of the day; exposing soybean seedlings with and without nodules grown in the greenhouse; exposing individual trifoliolate leaves at three canopy levels on field grown soybeans during reproductive growth with and without nodules; and exposing field grown soybeans with and without nodules during two stages of reproductive growth. Nodulated plants exposed to $^{14}CO_2$ at the mid-bloom stage exported from their leaves 16.9% of the total recovered ^{14}C assimilates by the end of a one hour labeling period. By the end of 24 hours, average leaf export was 36.9%. Leaves labeled during the times associated with the highest net carbon exchange assimilated more ^{14}C, translocated more to the stem and root and exhibited a higher rate of export from the leaves. Percent total recovered ^{14}C in each component was significantly different between 9 am and 3 pm, while differences during the mid-day periods were relatively small. Plants exposed to $^{14}CO_2$ during rapid bean filling held over 90% of the total recovered ^{14}C at the labeled node after 24 hours. Little export from a labeled trifoliolate leaf was found until one hour after exposure, but by 24 hours more than 60% of the total recovered ^{14}C was found in the podded stem component. No effect of leaf location on the degree of ^{14}C export or overall distribution was found, especially at the bean filling stage. After flowering, little increase in nodule dry weight occurred and little ^{14}C was ever found in the nodule component at a given harvest time. Apparently, during bean filling, total export to the nodules is considerably reduced although the total amount of ^{14}C assimilates translocated to the nodules and re-translocated to the filling pods could not be evaluated from the data. The data from these experiments may support the hypothesis that N_2 fixation by the symbiotic bacteria in legume root-nodules is regulated by the total partitioning of the available carbohydrates between the various metabolic sinks active at a particular stage of development. (Diss. Abstr. Int., B)

New Tracer Techniques

Refer also to abstracts 28975, 29162, 29164, 29188, 29923, 29971, and 32274.

29987 (CEA-CONF-2553) PART I. ON-LINE SYSTEM FOR THE MEASUREMENT OF CEREBRAL BLOOD FLOW BY ISOTOPIC CLEARANCE. PART II. SYSTEM FOR THE ACQUISITION AND PROCESSING OF DATA FOR THE MEASUREMENT OF CEREBRAL BLOOD FLOW BY THE METHOD OF ISOTOPIC CLEARANCE. Mamo, H.; Grimont, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Services d'Electronique). 1973. 6p. (In French). (CONF-731164-2). Dep. NTIS (US Sales Only) $4.00.

From information meeting on biomedical electronics; Saclay, France (27 Nov 1973).

The isotopic clearance method gives a quantitative estimate of cerebral blood circulation conditions. The importance of the cerebral blood flow-rate evaluation in physiology, pathology, and radioisotope scanning are analyzed. A ^{133}Xe bubble is injected into the brain and diffuses in the tissues, the washout time depending on the blood flow rate. The local measurement is carried out with several collimated detectors observing different zones of the brain. The data acquisition and treatment system is described. (FR)

29988 (CNEA-377) PREPARATION OF SPECIFIC ANTIBODIES AND THEIR APPLICATIONS IN INSULIN AND GROWTH HORMONE RADIOIMMUNOASSAY. Cresto, J. C.; Dujovne, I. L.; Albani, H.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1974. 20p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

The preparation and immunologic control is described of anti-porcine insulin, anti-bovine insulin, anti-HGH guinea pig sera and also of anti-guinea pig gamma globulin rabbit serum. Iodine-125 is used as the label. The sera thus prepared showed a suitable behavior for its application to insulin and HGH radioimmonoassay in human beings. (auth)

29989 (ORNL-TM-4860) NUCLEAR MEDICAL COMMITTEE REPORT. Adelstein, S. J.; Beck, R. N.; Miraldi, F. D.; Tubis, M.; Wagner, H. N. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 40p. Dep. NTIS $5.00.

Proposed research programs at ORNL in the field of nuclear medicine are presented. It is pointed out that many unique resources are available in terms of personnel, radionuclide production facilities, animal facilities, computer facilities, and instrument development facilities. (CH)

29990 (WANL-TME-1650) HIGH FREQUENCY ANALYSIS OF ELECTROCARDIOGRAM DATA USING CORRELATION TECHNIQUES. James, L. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Aug 1967. 121p. Dep. NTIS $9.25.

Data correlation processing techniques developed in the Nuclear Engine Rocket Vehicle program were applied to the analysis of electrocardiogram data. The basic objective of the study was to obtain power spectral density data, derived from the autocorrelation function, that hopefully would display data characteristics that could be easily identified by an untrained observer for the purpose of differentiating between normal and abnormal cardiac conditions. The processing method, a presentation and analysis of final spectral density results including raw data wave shapes, pertinent auto and cross-correlation function results, and problems encountered, proposed solutions, and future work are discussed. (CH)

29991 MEASUREMENT OF HUMAN DOPAMINE-β-HYDROXYLASE IN SERUM HOMOLOGOUS RADIOIMMUNOASSAY. Rush, R. A.; Thomas, P. E.; Udenfriend, S. (Hoffmann-La-Roche, Inc., Nutley, NJ). Proc. Nat. Acad. Sci. U. S. A.; 72: No. 2, 750-752 (Feb 1975).

Human serum dopamine-β-hydroxylase [3,4-dihydroxyphenylethylamine, ascorbate:oxygen oxidoreductase (β-hydroxylating), EC 1.14.17.1] levels have been determined in 52 samples with a newly devised radioimmunoassay that utilizes purified human enzyme and its specific antiserum. The values obtained were in excellent agreement (correlation coefficient $r = 0.98$) with those obtained by measuring enzymatic activity in the same sera. Either assay technique, enzymatic or homologous radioimmunoassay, can be used for measurement of the enzyme in normal human serum. (auth)

29992 DETECTION OF CANINE KIDNEY ALLOGRAFT REJECTION WITH ^{51}Cr-LABELED LYMPHOCYTES. Williams, L. E.; Merino, G. E.; Goren, G.; Najarian, J. S.; Loken, M. K. (Univ. of Minnesota, Minneapolis). Radiology; 115: No. 1, 205-206(Apr 1975).

Mongrel dogs received transplanted kidneys following total nephrectomy. The whole blood was centrifuged to separate out the lymphocytic fraction, which was tagged with ^{51}Cr. Renal accumulation of ^{51}Cr was followed using imaging detectors. All allograft rejections were accompanied by a simultaneous rise in the count rate. Labeled lymphocytes can be used to detect canine renal rejection, and the authors feel that this technique can be applied to man. (auth)

29993 CHOLESCINTIGRAPHY WITH ^{99m}Tc-PENICILLAMINE. Krishnamurthy, G. T.; Tubis, M.; Blahd, W. H.; Endow, J. S. (VA Wadsworth Hospital, Los Angeles). Radiology; 115: No. 1, 201-204(Apr 1975).

D-penicillamine labeled with ^{99m}Tc (Tc-Pen) was used for cholescintigraphy in dogs and man. Satisfactory images of the gallbladder were obtained using a scintillation camera fitted with a pinhole collimator. The results of cholescintigraphy and contrast cholecystography compared favorably. The authors suggest that Tc-Pen is taken up by the hepatocytes and excreted into the bile canaliculi which enter the gallbladder. Tc-Pen may prove to be an ideal agent for evaluation of hepatocellular function. (auth)

29994 HUMAN CNS PERFUSION SCANNING WITH ^{123}I-IODOANTIPYRINE. Uszler, J. M.; Bennett, L. R.; Mena, I.; Oldendorf, W. H. (Harbor General Hospital, Torrance, CA). Radiology; 115: No. 1, 197-200(Apr 1975).

Regional perfusion scanning of the central nervous system requires lipophilic radionuclides that rapidly penetrate the intact blood brain barrier. The first compound of this type to be developed for human use in ^{123}I-iodoantipyrine. ^{123}I-iodoantipyrine rapidly crosses the blood brain barrier and is flow-limited in its delivery to the brain. This makes possible the CNS perfusion scanning of the human brain, thereby showing regional distribution of microcirculatory blood flow. (auth)

29995 THYROID IMAGING IN LYMPHOCYTIC THYROIDITIS. Paull, B. R.; Alderson, P. O.; Siegel, B. A.; Bauer, W. C.; Evens, R. G. (Washington Univ., St. Louis). Radiology; 115: No. 1, 139-142(Apr 1975).

The thyroid radionuclide images of 51 adult patients with a histological diagnosis of either Hashimoto's thyroiditis (HT) or chronic lymphocytic thyroiditis (CLT) were reviewed. The findings were variable but similar in the two groups, the most common being a multinodular pattern and the presence of hypofunctional nodules. Thyroid carcinoma was found in 2 of 41 patients with CLT and in 4 of 10 with HT. In a patient with clinical or laboratory evidence of HT and the radionuclide image finding of a cold nodule, thyroid carcinoma should be excluded by surgical biopsy. (auth)

29996 DETERMINATION OF CEREBRAL DEATH BY RADIONUCLIDE ANGIOGRAPHY. Mishkin, F. (Drew Postgraduate Medical School, Los Angeles). Radiology; 115: No. 1, 135-137 (Apr 1975).

A unique appearance was seen in 18 of more than 4,000 radionuclide cerebral angiographic studies performed over a period of 5 years in patients who had cerebral death. Absence of cerebral perfusion was indicated by a lack of intracerebral activity and nondelineation of the sagittal sinus during the first minutes after the appearance of scalp activity. This technique provides a sensitive, unambiguous means of identifying a lack of cerebral perfusion. (auth)

29997 ABNORMAL BONE SCAN IN INTRACRANIAL LESIONS. Grames, G. M.; Jansen, C.; Carlsen, E. N.; Davidson, T. R. (Loma Linda Univ., CA). Radiology; 115: No. 1, 129-134(Apr 1975).

In 43 patients with abnormal brain scans restudied within 2–7 days with ^{99m}Tc-labeled ethane-1, hydroxy-1, diphosphonate (EHDP), cerebral infarctions, primary and metastatic neoplasms, chronic subdural hematoma, arteriovenous malformations and inflammatory lesions were visualized. The localization of EHDP in primary and metastatic neoplasms is usually less apparent than pertechnetate. Conversely, the localization of EHDP in cerebral infarctions is usually more apparent than pertechnetate. ^{99m}Tc-EHDP, in conjunction with pertechnetate, may become useful in differentiating cerebral infarctions from neoplasms. Further, skull scans must be interpreted with the appreciation that bone-seeking radiopharmaceuticals may localize in a variety of intracranial lesions. (auth)

29998 MANIFESTATIONS OF DIAPHRAGMATIC AND JUXTADIAPHRAGMATIC DISEASES IN THE LIVER–SPLEEN SCINTIGRAPH. Go, R. T.; Tonami, N.; Schapiro, R. L.; Christie, J. H. (Univ. of Iowa, Iowa City). Radiology; 115: No. 1, 119-127(Apr 1975).

Diaphragmatic and juxtadiaphragmatic abnormalities can be recognized on liver-spleen scintigraphs by alteration of the normal disparity in height between the liver and the spleen and by flattening of the superior margins of the liver and spleen. A unilateral abnormality is manifested by exaggeration or reversal of the normal disparity in height between the superior margins of the liver and spleen by cephalad or caudad displacement of one of these organs. Bilateral peridiaphragmatic abnormalities are manifested by flattening of the superior margins of the liver and spleen by caudad displacement of both organs. (auth)

29999 APPRAISAL OF THE ANGIOGRAPHIC CIRCULATION TIME AS AN INDEX OF CEREBRAL BLOOD FLOW. Gado, M.; Eichling, J.; Grubb, R. Jr.; Phelps, M.; Raichle, M.; Ter-Pogossian, M. M. (Washington Univ., St. Louis). Radiology; 115: No. 1, 107-112(Apr 1975).

The relationship of the brain angiographic mode circulation time (AVCT) to the mean transit time of the vascular indicator $C^{15}O$-labeled hemoglobin ($\bar{t}_{C^{15}O}$) and the regional cerebral blood flow (rCBF) as measured by the clearance of the diffusible tracer $H_2{}^{15}O$ was examined in 38 patients with selected cerebral diseases. The results demonstrate a predictable relationship does exist between the rCBF and $\bar{t}_{C^{15}O}$. This relationship is linear when plotted as $\bar{t}_{C^{15}O}$ vs. 1/CBF. Further, $\bar{t}_{C^{15}O}$ can be estimated with sufficient accuracy from the AVCT to permit at least a qualitative assessment of rCBF from the cerebral angiogram. (auth)

30000 DIAGNOSIS OF MIDGUT MALROTATION WITH ^{99m}Tc-PERTECHNETATE ABDOMINAL IMAGING. Leonidas, J. C.; Stuber, J. L.; Ashcraft, K. W. (Children's Mercy Hospital, Kansas City, MO). Radiology; 115: No. 1, 143-144(Apr 1975).

In a six-year-old girl with recurrent abdominal pain, abdominal imaging with technetium-99m pertechnetate was performed to detect ectopic gastric mucosa in a Meckel's diverticulum but was negative in this respect. The pattern of radioactivity, moving from the stomach to the proximal small bowel, showed abnormal localization and high concentration of the radionuclide to the right of the midline, indicating midgut malrotation and obstruction. This was subsequently confirmed at exploratory laparotomy. (auth)

30001 DETERMINATION OF CHORIONIC GONADOTROPIN BY THE RADIOIMMUNOLOGICAL METHOD. Strel'tsova, N. A. (Inst. of Obstretics and Gynecology, Leningrad). Probl. Endokrinol.; 21: No. 1, 49-51(1975). (In Russian).

Use of the highly purified HCG preparation for iodation permits application of inadequately specific antiserum without loss of sensitivity or specificity of the method. There were no significant differences in the CG level in the urine of pregnant women in determination by the method described and with the aid of radioimmunological sets. (auth)

30002 POTENTIAL NEW BRAIN-SCANNING AGENT: 4-^{77}Br-2,5-DIMETHOXYPHENYLISOPROPYLAMINE (4-Br-DPIA). Sargent, T. III; Kalbhen, D. A.; Sulgin, A. T.; Stauffer, H.; Kusubov, N. (Univ. of California, Berkeley). J. Nucl. Med.; 16: No. 3, 243-245(Mar 1975).

A centrally active drug containing bromine has been synthesized with ^{82}Br and ^{77}Br and appears to concentrate in normal human brain tissue, suggesting its potential use as a brain-scanning agent. (auth)

30003 RADIOACTIVE EMBOLIZATION FROM UPPER-EXTREMITY THROMBOPHLEBITIS. Lutzker, L. G.; Perez, L. A. (Albert Einstein Coll. of Medicine, Bronx, NY). J. Nucl. Med.; 16: No. 3, 241-242(Mar 1975).

A lung scan in a patient with upper-extremity thrombophlebitis showed hot spots that apparently resulted from embolization of a propagative thrombus. (auth)

30004 ANAPHYLACTOID REACTION TO HUMAN ALBUMIN MICROSPHERES. Littenberg, R. L. (Tripler Army Medical Center, Honolulu, Hawaii). J. Nucl. Med.; 16: No. 3, 236-240 (Mar 1975).

The first case of an anaphylactoid reaction to the intravenous administration of ^{99m}Tc-labeled human albumin microspheres is reported. (auth)

30005 RADIONUCLIDE DETECTION OF A PHEOCHROMOCYTOMA. Petrocelli, R. D.; Wetzel, R. A. (William Beaumont Hospital, Royal Oak, MI). J. Nucl. Med.; 16: No. 3, 234-235 (Mar 1975).

An area of increased radioactivity was visualized superior to the right kidney during the flow phase of a routine radionuclide renal angiography using ^{99m}Tc-Sn-DTPA. This same area failed to concentrate the radiopharmaceutical during delayed static images. This sequence suggested a highly vascular mass above the right kidney. The mass proved to be an adrenal pheochromocytoma as was suggested by the radionuclide study. (auth)

30006 RADIOCHROMATOGRAPHIC QUALITY CONTROL: A SIMPLIFIED SYSTEM. Sunderland, M. L. (Veterans Administration Hospital, Gainesville, FL). J. Nucl. Med.; 16: No. 3, 225-227(Mar 1975).

A simple means of graphically displaying the degree of radiocompound binding purity using a shielded G-M tube integrated with a rate meter and strip chart recorder is described. The instrument produces a permanent quality-control record and eliminates time-consuming radiochromatographic segment counting. (auth)

30007 SCINTIGRAPHIC IMAGING OF A BLIND-ENDING URETERAL DUPLICATION. Dublin, A. B.; Stadalnik, R. C.; DeNardo, G. L.; Vogel, J. M. (Univ. of California, Davis). J. Nucl. Med.; 16: No. 3, 208-209(Mar 1975).

The scintigraphic image using ^{131}I-hippuran is compared with the urographic appearance of blind-ending ureteral duplication. (auth)

30008 BRAIN TUMOR-SCANNING AGENTS COMPARED IN AN ANIMAL MODEL. Konikowski, T.; Jahns, M. F.; Haynie, T. P.; Glenn, H. J. (Univ. of Texas, Houston). J. Nucl. Med.; 16: No. 3, 200-207(Mar 1975).

Sixteen radiopharmaceuticals for brain tumor localization have been compared in a mouse brain tumor model. A rating system is presented for such intercomparison. The results indicate that ^{111}In-chloride injected at pH 1.5 has the most favorable biologic characteristics for brain tumor imaging. (auth)

30009 CHANGES IN LIVER SCAN FOLLOWING SPLENECTOMY. Custer, J. R.; Shafer, R. B. (Veterans Administration Hospital, Minneapolis). J. Nucl. Med.; 16: No. 3, 194-195(Mar 1975).

Changes in liver shape, position, and uptake of colloid have been noted by us in liver scans in patients following splenectomy. These changes have resulted in confusion in interpretation. Four cases are described to illustrate some of the possible misinterpretations. These include migration of the left lobe of the liver into the left upper quadrant mimicking residual or accessory spleen, mass lesion in the region of the porta hepatis, or recurrent foci of disease. (auth)

30010 CHANGES IN ^{87m}Sr CONCENTRATIONS IN SKELETAL METASTASES IN PATIENTS RESPONDING TO CYCLICAL COMBINATION CHEMOTHERAPY FOR ADVANCED BREAST CANCER. Gillespie, P. J.; Alexander, J. L.; Edelstyn, G. A. (Northern Ireland Radiotherapy Centre, Belfast). J. Nucl. Med.; 16: No. 3, 191-193(Mar 1975).

Serial ^{87m}Sr bone scintigrams were performed on a series of patients being treated by cyclical combination chemotherapy for metastatic breast cancer. All the patients investigated responded to the chemotherapy, but initially the scintigrams showed an apparent deterioration, in that the tumor-to-normal isotope uptake ratios increased. Following this initial flare the scintigram appearance improved with a decrease in the tumor-to-normal uptake ratio. It is suggested that deterioration in the scintigram in the early stages of treatment should not be regarded as an indication that the patient is failing to respond. (auth)

30011 MEASUREMENT OF PLASMA AND TISSUE TRIIODOTHYRONINE CONCENTRATION IN THE RAT BY RADIOIMMUNOASSAY. Nejad, I.; Bollinger, J.; Mitnick, M. A.; Sullivan, P.; Reichlin, S. (Univ. of Connecticut, Farmington). Endocrinology; 96: No. 3, 773-780(Mar 1975).

A radioimmunoassay method is reported for triiodothyronine (T_3) and the application of this assay to the study of plasma and tissue T_3 concentration in the rat. Several antisera formed to a T_3-bovine fibrogen complex in guinea pigs and T_3-thyroglobulin complex in rabbits are shown to have low or no cross reactivity with T_4, monoiodotyrosine, diiodotyrosine, tetraiodothyroacetic acid (TETRAC) and reverse T_3. Cross reactivity with T_3 derivatives, triiodothyroacetic acid (TRIAC), and triiodothyropropionic acid (TRIPROP) was variable, some antisera differentiating moderately well and others not at all. An extraction method is described, which removes approximately 85% of added ^{125}I-T_3 or unlabelled T_3 from tissues and in the final step represents 57% of total tissue T_3. Mean plasma T_3 in 5 normal male rats was 58 ± 6.0 ng/100 ml (SEM), in liver 769 ± 56 ng/100 g, and kidney 627 ± 39 ng/100 g. Tissue to plasma concentration gradients for liver and kidney were 13.3 and 10.8, respectively. (auth)

30012 DIRECT RADIOIMMUNOASSAY OF CORTICOSTERONE IN RAT SERUM. Gomez-Sanchez, C.; Murry, B. A.; Kem, D. C.; Kaplan, N. M. (Univ. of Texas, Dallas). Endocrinology; 96: No. 3, 796-798(Mar 1975).

A direct radioimmunoassay of corticosterone is described requiring as little as 1-2 μl of rat serum. After methanol inactivation of CBG, serum was assayed with a relatively specific antibody raised against corticosterone-21-hemisuccinate. While this antibody has a significant cross-reaction with cortisol, prior purification is not necessary since cortisol is not produced in the rat. (auth)

30013 RADIOIMMUNOASSAY OF CANINE GROWTH HORMONE: ENZYMATIC RADIOIODINATION. Hampshire, J.; Altszuler, N.; Steele, R.; Greene, L. J. (New York Univ.). Endocrinology; 96: No. 3, 822-828(Mar 1975).

A sensitive radioimmunoassay is described for the measurement of plasma concentrations of canine growth hormone (cGH) as low as 0.25 ng/ml. The assay utilizes enzymatically iodinated cGH and the double antibody technique. The mean plasma concentration of growth hormone in the normal dog after overnight fast is 1.75 ± .17 ng/ml. Exogenous cGH was cleared from the plasma of both the normal and hypophysectomized dog with a mean half-life of 25.6 ± 1.0 min and was distributed in a volume equal to 8.9% of the body weight. Insulin hypoglycemia produced a 3- to 5-fold increase in plasma GH in 4 of 6 dogs and arginine infusion failed to produce a statistically significant rise. (auth)

30014 PLATELETS: PRODUCTION, FUNCTION, TRANSFUSION, AND STORAGE. Conference Held in Boston, Massachusetts, June 7-9, 1973. Baldini, M. G.; Ebbe, S. (eds.). New York; Grune and Stratton, Inc. (1974). 430p. (CONF-730633-).

Thirty-six papers discuss the results of studies on the physiological mechanisms responsible for blood platelet production and the relationship of platelets to selected disease states. The effective utilization of platelet transfusions in the treatment of selected diseases and methods for the preservation of platelets during storage are discussed. The use of ^{51}Cr-labeled platelets for measurements of platelet kinetics in normal and pathological conditions and the use of ^{75}Se-selenomethionine to measure plasma thrombopoiesis-stimulating activity are described. A subject index is included and each paper includes a list of pertinent references. (CH)

30015 LIVER SCAN SHOWING INTENSE LUNG UPTAKE IN NEOPLASIA AND INFECTION. Imarisio, J. J. (Veterans Administration Research Hospital, Chicago). J. Nucl. Med.; 16: No. 3, 188-190(Mar 1975).

Two cases of intense lung activity uptake during routine liver imaging are presented. One patient died 6 days after uptake was seen, and had Kupffer cell tumor, or liver angiosarcoma, at autopsy. The second patient with an acute infection superimposed on alcoholic hepatitis showed intense lung uptake on the tenth day of a sustained course of very high fever. A repeat liver scan after the patient became afebrile showed no lung uptake. (auth)

30016 PULMONARY ARTERIOVENOUS MALFORMATION: SCINTIGRAPHIC DEMONSTRATION AND ANALYSIS. Weiss, M. A.; Koenigsberg, M.; Freeman, L. M. (Albert Einstein Coll. of Medicine, Bronx, NY). J. Nucl. Med.; 16: No. 3, 180-182 (Mar 1975).

Scintiphotographic demonstration of a pulmonary arteriovenous malformation in an 8-year-old child is presented. Using a data processor, the transit of radiopertechnetate through the lesion as well as various portions of the lung is shown. The steal of blood flow from the left lower lobe is documented. (auth)

30017 SOLID-PHASE RADIOIMMUNOASSAY FOR FIBRINOGEN. Crane, L. J.; Miller, D. L. (Roche Inst. of Molecular Biology, Nutley, NJ). Anal. Biochem.; 64: No. 1, 60-67(Mar 1975).

A solid-phase radioimmunoassay for fibrinogen has been developed utilizing [^{14}C]-methylated fibrinogen as standard antigen and fibrinogen-specific antibodies covalently linked to Sepharose. Fibrinogen was [^{14}C]-methylated by reductive alkylation using [^{14}C] formaldehyde and sodium borohydride. The methylated fibrinogen was unaltered in clotting ability and antigenicity. The assay, an isotope dilution assay, is quantitative for picomole amounts of fibrinogen. It is specific for fibrinogen in homologous plasma and in the presence of a variety of other proteins. (auth)

30018 RAPID, SIMPLE RADIOMETRIC ASSAY FOR CHOLINESTERASE, SUITABLE FOR MULTIPLE DETERMINATIONS. Johnson, C. D.; Russell, R. L. (California Inst. of Tech., Pasadena). Anal. Biochem.; 64: No. 1, 229-238(Mar 1975).

A rapid and simple radiometric assay for cholinesterase, suitable for multiple determinations, has been developed. (^{3}H-acetyl) choline is enzymatically hydrolyzed in a small reaction volume in a scintillation vial. The released [^{3}H] acetate is then extracted into a toluene-based scintillator added directly to the vial, without removing the reaction volume. The extracted [^{3}H] acetate counts efficiently, but the unhydrolyzed [^{3}H] acetylcholine remains unextracted in the small aqueous reaction volume, from which its weak β-particles of decay do not escape to excite the scintillator. The assay is highly reproducible, quite sensitive, and useful for applications in which multiple samples must be quickly assayed. (auth)

30019 CINEANGIOSCINTIGRAPHIC DEMONSTRATION OF CAROTID-BASILAR DELAY. Application in the Diagnosis of Vertebro-Basilar Insufficiency. Pouplard, F.; Cheguillaume, J.; Truelle, J. L.; Minier, J.; Emile, J. (Centre de Lutte Contre le Cancer Paul-Papin, 49 - Angers (France); Centre Hospitalier Universitaire, 49 - Angers (France)). Nouv. Presse Med.; 3: No. 28, 1755-1756(20 Jul 1974). (In French).

Gamma camera recording of an embolus of technetium-99m

injected into a vein of the antecubital fossa shows the presence of two curves corresponding to the posterior vascular axis and to the carotid siphon. It makes possible the definition of the delay between the two curves as being 1.5 seconds in the normal subject and 2 seconds in patients with vertebro-basilar insufficiency, given that there is no cerebral tumor (in which case the interval is greatly prolonged). (FR)

30020 SIMULTANEOUS RADIOIMMUNOASSAY OF PLASMA THYROXINE AND TRIIODOTHYRONINE: TECHNIQUE AND CLINICAL APPLICATIONS. Carayon, P.; Jaquet, P.; Codaccioni, J. L.; Vague, J. (Hospital de la Conception, 13-Marseille (France)). Ann. Endocrinol. (Paris); 35: No. 3, 275-276(May 1974). (In French).

A sensitive and precise radioimmunoassay has been developed for the simultaneous measurement of both thyroxine (T4) and triiodothyronine (T3) in 100 μl on unextracted plasma. Rabbit antisera of high affinity and specificity were raised against T3 or T4 conjugated to bovine serum albumin. Anilino-naphtalene sulfonic acid and ethyl-mercury-thiosalicylate were used to block thyroxine binding proteins. Standard curves were obtained with T3- and T4-free plasma. Antibody-bound and free hormones were separated with a charcoal-dextran-albumin mixture. (FR)

30021 PLASMA CORTISOL ASSAY. Radiocompetitive Assay of Cortisol without Chromatography. Jolivet, A. (Centre Hospitalier Universitaire, 94-Creteil (France)). Ann. Endocrinol. (Paris); 35: No. 3, 223-229(May 1974). (In French).

A method for rapid measurement of plasma cortisol is described. It utilizes human transcortin as binding protein; first extraction of plasma with petroleum ether and carbon tetrachloride, taking off competitive steroids, eliminates the need of chromatography. Sensitivity, reproducibility, and specificity are satisfactory and only 0.2 ml of plasma is necessary. This method has an application in some physiological and pathological situation as: pregnancy and adrenal hyperplasia. (FR)

30022 RADIOIMMUNOASSAY OF SERUM TRIIODOTHYRONINE AND ITS CLINICAL APPLICATIONS. Brunelle, P.; Laine, G.; Nouel, J. P.; Bohuon, C. (Centre Henri Becquerel, 76-Rouen (France)). Ann. Biol. Clin. (Paris); 32: No. 4, 323-331(1974). (In French).

A specific, sensitive, and reproducible estimation of serum triiodothyronine (T_3), without prior extraction is reported. The antibodies are induced by immunization with triiodothyronine bound to albumin. Thiomersal (ethylmercurithiosalicylate) inhibits the bond between ^{125}I-labelled T_3 and thyroid-binding globulin. At equilibrium, the immune complex is precipitated by rabbit antigammaglobulin antibodies. The reference values of serum triiodothyronine vary with the subject's age; the results found during various thyroid diseases are divided up into two age groups. The estimation of serum triiodothyronine was found to be particularly useful in the diagnosis of hyperthyroidism, e.g., simple, residual, following radioactive iodine treatment, or T_3 thyrotoxicosis, where the results are always high. It seems to be of lesser value in cases of hypothyroidism. Five euthyroid subjects with a hyperfixing autonomous nodule, had triiodothyronine levels higher than normal. In everyday practice, it seems to be necessary to carry out this estimation more rapidly if it is to become a routine test of thyroid function. (FR)

30023 ASSAY OF DUCK FSH USING A MAMMALIAN HETEROLOGOUS FSH RADIOIMMUNOASSAY. Croix, D.; Hendrick, J. C.; Balthazart, J.; Franchimont, P. (Liege Univ. (Belgium)). Compt. Rend. Soc. Biol.; 168: No. 1, 136-140(1974). (In French).

A heterologous system using ^{125}I-labelled rat FSH and an anti-ovine FSH antiserum allowed the FSH assay in the duck. Hence there is a radioimmunological cross reaction with mammalian FSH. The antiserum used cross reacted with the antigenic sites of the β subunit of FSH carrying the biological activity. Nevertheless, the tertiary structure obtained by the α and β subunit association is necessary for the fixation of the antibodies on the β sites. (FR)

30024 OCULAR SCINTIGRAPHY. Blanquet, P.; Safi, N. (Hopital Saint-Andre, 33-Bordeaux (France). Lab. des Isotopes; Institut National de la Sante et de la Recherche Medicale (INSERM), 33-Bordeaux (France). Unite de Recherches sur les Applications Medicales et Biologiques des Isotopes Radioactifs); Verin, P. (Hopital des Enfants, 33-Bordeaux (France)). Nouv. Presse Med.; 3: No. 34, 2154-2158(12 Oct 1974). (In French).

Ocular scintigraphy may be carried out at present using several tracers: diiodofluoresceine ^{131}I and ^{99}Tc (TcO^{4-}) as indicators of hypervascularisation; chloroquine iodide ^{131}I, selective of melanoma. The detector used is an Anger scintillation camera coupled with a multiparametric analytical chain or to a calculator. The collimator, of pinhole type, has a stenopeic aperture opposite each eye and may be adapted according to the interpupillary distance. The methodology of scintigraphy, particularly simple, is described. The results, which form the basis for two statistical series, involving 198 and 80 patients respectively, relate to the main categories of ocular disorder encountered: malignant melanoma, other tumors, metastases, choroiditis, idiopathic retinal detachments, etc. Finally the value of double scintigraphy is stressed, DIF and Tc showing only hypervascularisation, often related to a tumor, whilst chloroquine iodide, when it gives a positive result, indicates the presence of a malignant melanoma. (FR)

30025 A METHOD FOR PREPARING A ^{99m}Tc RADIOPHARMACEUTICAL USED FOR DIAGNOSIS BY SCINTISCANNING. Bardy, A.; Beydon, J. (to CEA, 75-Paris (France)). French Patent 2,187,314/A/. 6 Jun 1972. 6p. (In French).

A method is described for preparing a polyphosphate-tin composition labelled with ^{99m}Tc intended for medical diagnosis by scintiscanning in particular for the diagnosis of the bone system. A polyphosphate solution is admixed with a freshly prepared stannous chloride solution, neutralization is carried out up to a pH of about 6.3, the mixture thus obtained is lyophilized so as to provide a powder and that powder is admixed with a solution containing ^{99m}Tc, this latter step being carried out at the moment of use. The process can be applied to bone scintiscanning. (FR)

30026 ^{85}Sr IN THE DIAGNOSIS OF SKELETAL DISEASE. Firusian, N. (Essen Univ. (Gesamthochschule) (F. R. Germany). Innere Klinik und Poliklinik-Tumorforschung). Deut. Med. Wochenschr.; 99: No. 33, 1648-1649(Aug 1974). (In German).

Strontium-85, in a dose of 0.2 mCi, was administered to ten persons without skeletal disease (group I), seven with metastatic destruction of vertebrae by solid tumors, and two with malignant systemic disease (group II), and five after circumscribed radiotherapy of vertebral metastases (group III). External measurement gave an average effective half-life of 7.8 days in group I, 23.9 days in group II, and in group III a result similar to that in group I. Animal experiments have shown that the effective half-life is normal in fresh and old fractures. Measurements of the effective half-life of ^{85}Sr by external measurement, taken in conjunction with skeletal isotope scanning, can be used in the differential diagnosis of circumscribed skeletal disease. (auth)

30027 SPLENIC SCINTIGRAPHY. Fretault, J. (Centre Hospitalier Universitaire Broussais-Hotel-Dieu, 75-Paris (France)). Ann. Gastroenterol. Hepatol.; 10: No. 5, 437-445(Oct 1974). (In French).

Splenic scintigraphy like other scintigraphic techniques uses short-lived radioelements, which obtain well-contrasted pictures, at the price of only light irradiation, permit the renewal of these examinations without increase of terratogenic risk, do not get in the way of other ulterior isotopic studies, and collects information in numerical form. This numerical scintigraphy, which should be developed in coming years, will have the advantage of suppressing subjective difficulties of lecture. This method, easy to apply, is without danger to the patient and constitutes with the techniques of arteriography of the coeliac trunk, one of the last acquisitions, that can help practitioner in the diagnosis of splenomegalies and hematosarcomas. (FR)

30028 A COMPARATIVE STUDY OF CARDIAC VASCULARIZATION AND MYOCARDIAL FUNCTION BY MEANS OF CORONAROGRAPHY AND SCINTIGRAPHY. Struyven, J.; Destailleur, G.; Telerman, M. (Hopital Universitaire Brugmann, Brussels (Belgium)). J. Radiol., Electrol., Med. Nucl.; 55: No. 8, 583-586 (Aug 1974). (In French).

A comparative study of the data obtained by means of coronarography, ventriculography, and cardiac scintigraphy was carried out. This survey involved 50 non-selected patients. Their ages ranged from 27 to 65. 36% had a painful thoracic syndrome producing changes in the electrocardiogram without myocardial infarction, and 64% had one or more infarctions. Coronarography and ventriculography were carried out by the perfemoral transcutaneous technique and cineangiography. Scintigraphic studies were carried out by the intracoronary and intravenous methods. The isotope used was cesium-131. Scintigraphs obtained by the two methods of injection are seen to coincide almost exactly. Comparison of coronarography, ventriculography, and scintigraphy shows that scintigraphy accurately pinpoints lesions of the anterior ventricular wall, that it can reveal areas poorly irrigated by the coronaries, but that it does not usually detect posterior lesions. (FR)

30029 NEW COMPOSITIONS FOR THE LOCALIZATION OF DEEP-SEATED VASCULAR THROMBI BY MEANS OF A RADIOACTIVE TRACER. Dugan, M. A. (to Research Corp., New York (USA)). German(FRG) Patent 2,336,751/8/. 28 Feb 1974. 8p. (In German).

The invention deals with radioactive labelled thrombolytic enzymes. The patent claims concern ^{99m}Tc-streptokinase with

an activity between 0.8 and 2.5 mCi per 10 Kin streptokinase and ^{99m}Tc-urokinase having an activity between 0.8 and 2.5 mCi per 10 Kin urokinase and the production of these. Furthermore, the patent claims deal with a method to detect thrombo-embolism, which is characterized in that 8 to 350 kin of a physiologically ingestible solution of streptokinase or urokinase labelled with ^{99m}Tc with an intensity between 1 and 20 mCi/kin, are injected into the system to be examined and the position of increased gamma radiation is plotted or scanned. (GE)

30030 AUTOMATIC DEVICE FOR EXPOSURE OF PLANTS TO $^{14}CO_2$-LABELLED ATMOSPHERE. Hanker, I. (Radioizotopova Laborator Ustavu Ochrany Rostlin VURV, Prague). Radioisotopy; 16: No. 1, 123-147(1975). (In Czech).

An automatic device for plant exposure to $^{14}CO_2$-labelled atmosphere was constructed for the study of the effects of pesticides on the metabolism and photosynthesis of crop plants. In addition to constant illumination and temperature conditions, the exposure chamber also maintains automatically a constant concentration of CO_2 and $^{14}CO_2$ throughout the entire experiment. (auth)

30031 SCINTIGRAPHIC IMAGE OF THE THYROID GLAND IN LARGE-CELL EOSINOPHILIC TUMORS-HURTHLE-CELL ADENOMA AND LANGHANS' STRUMA. Razpopova, M.; Simeonov, L.; Atanasov, A.; Simeonova, E. (Central Radioisotope Foundation, Sofia). Probl. Endokrinol.; 21: No. 1, (1975). (In Russian).

Thirteen patients (12 women and 1 man), chiefly aged from 40 to 60 years and suffering from Langhans struma and Hurthle-cell adenoma were examined and operated on. Scintigraphic study of the thyroid gland was conducted in 6 patients with histologically proved Hurthle-cell adenoma; warm nodes were revealed in 3 and cold nodes also in 3 cases. Three scintigraphic images with a cold node and 1—with a warm node were obtained in the patients with Langhans struma. In one case with a hot node and in one case with a warm node of the Hurthle group there was a clinical picture of moderately severe thyrotoxicosis. The differences in the thyroscintigraphic pictures in eosinophilic tumors pointed to the necessity of additional clinical and laboratory investigations. (auth)

30032 BASIC SCIENCE PRINCIPLES OF NUCLEAR MEDICINE. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Company (1974). 278p. $22.50.

Separate abstracts were prepared for the nine chapters in this publication. (ERB)

For abstracts of individual chapters see: 29683 and 30033–30040.

30033 MATHEMATICAL PRINCIPLES. Dalrymple, G. V. (Univ. of Arkansas, Little Rock). pp 1-31 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

The mathematical applications in nuclear medicine assume two forms. First, certain calculations must be made to analyze patient data. Second, mathematical notation serves to provide descriptions of processes. The goal is to provide the reader with manipulative skills for those operations used in the calculations while providing communicative skills for understanding mathematical notation when it appears in the literature. (ERB)

30034 PHYSICS. Prior, M. (Univ. of Arkansas, Little Rock). pp 32-81 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

This chapter is intended to present the basic physics necessary for nuclear medicine. However, much of the material here is not what is presented in basic physics courses. The physical basis of nuclear medicine lies largely in the area known as modern physics, encompassing especially quantum mechanics and nuclear physics. Many books are available that discuss these and other parts of physics. One chapter cannot present the same detail as whole books, but the intent is to present the essential concepts necessary for the application. The basic terminology and concepts of classical physics are presented briefly, followed by the concepts of relativity and quantum mechanics. The rest of the chapter is a discussion of the physical principles and relationships pertinent to nuclear medicine in terms of the basic concepts presented at the beginning. (ERB)

30035 CHEMICAL PRINCIPLES. Moss, A. J. Jr.; Prior, R. M.; Slayden, J. E.; Nash, J. C. (Univ. of Arkansas, Little Rock). pp 82-106 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

Following a brief discussion of chemical fundamentals including chemical bonds, chemical equilibrium, and chemical and enzyme kinetics, the principle of the radioimmunoassay is discussed. The production of short-lived radioisotopes in nuclear reactors and accelerators (cyclotrons) is also discussed. The general chemical, biological, and physical bases for some of the radionuclides and radiopharmaceuticals used in clinical nuclear medicine are reviewed with particular emphasis on current problems and applications in the area of radiopharmaceuticals. (ERB)

30036 TRACER PRINCIPLES. Boyd, C. M.; Dalrymple, G. V. (Univ. of Arkansas, Little Rock). pp 107-138 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

Following a brief section on the terminology used in tracer techniques, a discussion of the application of tracer techniques in static and kinetic systems is presented. The former system is a less complicated system in which straightforward tracer dilution concepts are used. The latter system is a more complex system which may involve multicompartmental analysis. The mathematics of the various analysis techniques from the simple to the complex are discussed. Examples of the different systems involved in tracer techniques are illustrated. (ERB)

30037 RADIATION BIOLOGY. Baker, M. L. (Univ. of Arkansas, Little Rock). pp 139-156 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

This brief overview of radiation biology as it relates to nuclear medicine is divided into two sections. In the first, the interaction of radiation with matter is discussed beginning at the molecular level and proceeding through the gene, chromosome, and cellular level to that of the whole animal. In the second section, the isotopes common to nuclear medicine are covered. Possible modes of action and radiobiological consequences of these actions are discussed. (ERB)

30038 HEALTH PHYSICS. Vandergrift, J. F. (Univ. of Arkansas, Little Rock). pp 157-168 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

Health physics as applied to nuclear medicine must encompass the entire spectrum of activities involved. It must be considered in pharmaceutical selection, instrumentation employed, facility design, occupational safety, and public health, as well as many other areas, if we are to continue to enjoy a high benefit-to-risk ratio. Understanding and safety consciousness are ultimately the only defense against the hazards of radiation. Safety standards and limits have been established in many instances and have proved to be reasonable and safe, when used with understanding and judgment. In many cases, radiation safety in nuclear medicine is a legal requirement and cannot be ignored without repercussions. Nuclear medicine is unique in its attention to patient, occupational, and community safety problems. This has been largely influenced by governmental regulations that control the manufacture, distribution, and use of radiopharmaceuticals. (ERB)

30039 ELECTRONICS. Prior, R. M. (Univ. of Arkansas, Little Rock). pp 169-197 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

A knowledge of the fundamentals of electronics is necessary for understanding the instrumentation of nuclear medicine. Understanding the instrumentation allows us to make the most efficient utilization of it while being aware of the capabilities and limitations. Electronics is based on the simple laws of physics that are concerned with electrical charges. Although modern instruments are not so simply described, the link between basic physics and modern electronics is a continuous path. The purpose of this chapter is to point out this link and to provide an understanding of the operation of basic, general, electrical circuits. Complex instruments are usually combinations of the basic circuits and circuit components. (ERB)

30040 COMPUTER APPLICATIONS IN NUCLEAR MEDICINE. Eason, C. S. (Univ. of Arkansas, Little Rock). pp 243-258 of Basic Science Principles of Nuclear Medicine. Boyd, C. M.; Dalrymple, G. V. (eds.). St. Louis; C. V. Mosby Co. (1974).

The terminology associated with computers is presented and some of the basic concepts of programming a digital computer are introduced. Basic assembly language is discussed. The tremendous speed and capabilities of modern digital computers make them a powerful and indispensable tool in nuclear medicine. (ERB)

30041 TECHNETIUM-99m-DIPHOSPHONATE ACCUMULATION IN AMYLOID. VanAntwerp, J. D.; O'Mara, R. E.; Pitt, M. J.; Walsh, S. (Univ. of Arizona, Tucson). J. Nucl. Med.; 16: No. 3, 238-240(Mar 1975).

A well-documented case of multiple myeloma complicated by histologically demonstrable amyloidosis is presented. Technetium-

99m-diphosphonate in the areas of amyloid deposition about the shoulders and hips is shown. This adds another dimension to the extraosseous sites without demonstrable calcification where accumulation of bone-seeking radiopharmaceutical can be observed. In patients where symmetrical uptake of such agents is noted in the periarticular soft tissue, particularly of the hips and shoulders, amyloidosis must become a diagnostic consideration. This is particularly true in patients presenting with undiagnosed arthralgia. (auth)

30042 RADIOISOTOPE SCINTIGRAPHY IN DIAGNOSIS OF BARRETT'S ESOPHAGUS. Berquist, T. H.; Nolan, N. G.; Stephens, D. H.; Carlson, H. C. (Mayo Clinic and Mayo Foundation, Rochester, MN). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 2, 401-411(Feb 1975).

From 74th annual meeting of the American Roentgen Ray Society; Montreal, Canada (25 Sep 1973).

Scanning of the esophagus with ^{99m}Tc pertechnetate for the diagnosis of Barrett's esophagus appears to be useful both in making the diagnosis and in helping to exclude it. The technique offers a noninvasive approach to the identification of columnar epithelium lining the lower esophagus and promises to be useful in better understanding the etiology of the disorder. (auth)

30043 DEVELOPMENT AND VALIDATION OF A RADIOIMMUNOASSAY FOR PEPTIDES RELATED TO β-MELANOCYTE-STIMULATING HORMONE IN HUMAN PLASMA: THE LIPOTROPINS. Gilkes, J. J. H.; Bloomfield, G. A.; Scott, A. P.; Lowry, P. J.; Ratcliffe, J. G.; Landon, J.; Rees, L. H. (Bartholomew's Hospital, London). J. Clin. Endocrinol. Metab.; 40: No. 3, 450-457(Mar 1975).

A radioimmunoassay is described for the measurement of human "β-melanocyte-stimulating hormone"("β_h-MSH"). Two antisera have been used, one of which cross-reacts with synthetic β_h-MSH as well as with the two larger pituitary peptides β_h- and γ_h-lipotropin (β_h- and γ_h-LPH) and the other mainly with β_h-MSH and γ_h-LPH. The sensitivity and reliability of the assay have been improved by employing a simple plasma extraction procedure, and the shelf-life of the iodinated β_h-MSH tracer has been increased more than five-fold by storage in a concentrated human serum albumin solution. Using a 5 ml plasma sample the detection limit is 6 pg/ml. The mean resting "β_h-MSH" level in normal subjects is 21 pg/ml (range 13 to 38 pg/ml) at 9 AM and 12 pg/ml (range 6 to 20 pg/ml) at 9 PM. Levels are considerably elevated (51 to 12,000 pg/ml) in patients with Addison's disease, Nelson's syndrome, Cushing's disease and the "ectopic" ACTH syndrome. After administration of insulin or pyrogen, the concentration of plasma "β_h-MSH" increases in parallel with that of ACTH and they are approximately equivalent on a molar basis. The stability of purified β_h- and γ_h-LPH, and endogenous "β_h-MSH" when incubated in vitro in fresh blood or plasma is similar, in contrast to the less stable peptide synthetic β_h-MSH. It is suggested that "β_h-MSH" immunoreactivity in human plasma is due to β_h- and γ_h-LPH rather than β_h-MSH. (auth)

30044 QUANTITATION OF VALVULAR INSUFFICIENCY BY COMPUTERIZED RADIONUCLIDE ANGIOCARDIOGRAPHY. Kirch, D. L.; Metz, C. E.; Steele, P. P. (Univ. of Colorado, Denver). Amer. J. Cardiol.; 34: 711-721(Nov 1974).

Linear differential equation techniques for modeling tracer dynamics that assume constant flow rates and fixed chamber volumes are not totally suitable for describing the pulsatile conditions of cardiac tracer dynamics. In this paper, z-transformation methods for solving finite difference equations have resulted in a set of solutions for a pulsatile flow model of the atrial-ventricular-arterial system that accurately describes the cardiac dynamics associated with valvular insufficiency. This model can be applied to data extracted from radionuclide angiocardiographic studies on patients with mitral or aortic insufficiency as well as tricuspid or pulmonary insufficiency. Application of the model requires that the proximal atrium be labeled by a discrete bolus injection of radionuclide. Rapid sequential scintigraphic images are then recorded by an Anger camera-computer system, and the time-activity curves extracted from the resulting dynamic data are representative of the activity in the atrium and ventricle as functions of time. Determination of at most four parameters from this pair of curves then permits quantitation of total, forward and regurgitant ejection fractions and regurgitant fractions. In addition, end-diastolic and end-systolic cardiac chamber volumes can be computed from forward stroke volume. These quantities, determined by radionuclide angiocardiographic methods in 12 patients with mitral or aortic insufficiency, are compared with results from conventional contrast angiographic studies. (auth)

30045 USE OF RADIOIMMUNOASSAYS TO DETERMINE THE CONCENTRATION OF STREPTOCOCCAL GROUP-SPECIFIC ANTIBODIES IN RABBIT ANTISERA. Bernstein, D.; Klapper, D. G.; Krause, R. M. (Rockefeller Univ., New York). J. Immunol.; 114: No. 1, 59-63(Jan 1975).

A radioimmunoassay was developed for the quantitation of antibodies to the Group A, A-variant, and C carbohydrates in rabbit streptococcal antisera. The assay employs radiolabeled purified Group carbohydrate which has been tyrosylated to allow for incorporation of ^{125}I. This assay has an advantage over the quantitative precipitin test because it measures non-precipitating antibody in addition to precipitating antibody. Furthermore, 7S anti-IgG in rabbit antisera gives a falsely elevated value for the antibody concentration in the quantitative precipitin test. This did not occur with the radioimmunoassay. The assay described is reproducible, sensitive, and uses little antisera. (auth)

30046 DATA STORAGE AND RETRIEVAL SYSTEM FOR A NUCLEAR MEDICINE DEPARTMENT. Reinke, D. B.; Damm, D. W.; Dunn, B.; Shafer, R. B. (Veterans Administration Hospital, Minneapolis). J. Nucl. Med.; 16: No. 4, 275-279(Apr 1975).

A mark sense IBM data card was designed specifically for the nuclear medicine department. The data card functions as a flow sheet with coded information added in sequence by secretary, technician, and physician. Statistical information, patient identification, quantitative results, physician interpretation, and discharge diagnosis can be easily coded and entered on the card by the appropriate individual. The completed card can be punched, filed, and retrieved by machine. Filing and retrieving can also be done by hand for flexibility. The stored data can easily be programmed and converted to computer handling and storage. The card is inexpensive to produce. Card design is extremely flexible for varying needs. If sorting and punching equipment is not available, this can be contracted for in the community at low cost. (auth)

30047 SIMPLE RADIOIMMUNOASSAY OF PLASMA TESTOSTERONE WITHOUT COLUMN CHROMATOGRAPHY. Castro, A.; Shih, H. H. W.; Chung, A. (United Medical Labs., Inc., Portland, OR). Steroids; 23: No. 5, 625-638(May 1974).

A sensitive, specific, and accurate direct radioimmunoassay of plasma testosterone without chromatography is described. A hexane pre-extraction step is employed before solvent extraction and immunoassay. Antiserum to testosterone was generated in rabbits inoculated with testosterone-3-oxime-bovine serum albumin conjugates. The antiserum was used at a final dilution of 1:60,000. The mean recovery of labelled 1,2-^{3}H-testosterone added to samples processed without column chromatography was about 10% higher than with column chromatography. Good correlation was found between the results determined on 12 pairs of samples with and without the use of column chromatography (male: $r = 0.9559$; female: $r = 0.9417$). The intra-assay coefficient of variation was 4.3% for 10 samples and the interassay precision was 8.4% for 30 samples. The accuracy was satisfactory with a recovery correlation coefficient of 0.997. The specificity of the antibody was examined by intubation with 15 different steroids. 17β-hydroxy-5α-androstan-3-one interference was found at its normal level. Sensitivity was 10 pg per sample and blanks were negligible. The normal testosterone levels (mean ± S. D.) obtained were 550 ± 187 ng/100 ml (N = 10) in males with a range of 357 to 991 ng/100 ml., and 40 ± 9 ng/100 ml (N = 6) in females with a range of 24 to 50 ng/100 ml. (auth)

30048 SIMULTANEOUS RADIOIMMUNOASSAY OF TESTOSTERONE AND DIHYDROTESTOSTERONE. Barberia, J. M.; Thorneycroft, I. H. (Univ. of Southern California, Los Angeles). Steroids; 23: No. 5, 757-766(May 1974).

A radioimmunoassay, which simultaneously measures both testosterone (T) and dihydrotestosterone (DHT) in the same serum sample, is presented. Celite column chromatography is employed to separate T from DHT, and these two steroids from other potentially cross-reacting and interfering steroids. The normal values for men, women in the follicular phase, women in the luteal phase, ovariectomized and adrenalectomized women, post-menopausal women, and ovariectomized women for T are 5,140 ± 1190 pg/ml, 307 ± 97 pg/ml, 285 ± 46 pg/ml, undetectable (< 5 pg/ml), 262 ± 47 pg/ml and 199 ± 44 pg/ml; and for DHT 470 ± 165 pg/ml, 160 ± 45 pg/ml, 147 ± 44 pg/ml, undetectable (< 5 pg/ml), 168 ± 27 pg/ml, 94 ± 15 pg/ml. The maximum sensitivity of the method was 10 pg/ml for T and 14.3 pg/ml for DHT when 1 ml was extracted. The blank in most assays was undetectable, but rarely exceeded 10 pg. (auth)

30049 GALLIUM-67-CITRATE SCANNING FOR THE LOCALIZATION AND STAGING OF LYMPHOMAS. Adler, S.; Parthasarathy, K. L.; Bakshi, S. P.; Stutzman, L. (New York State Dept. of Health, Buffalo). J. Nucl. Med.; 16: No. 4, 255-260(Apr 1975).

One-hundred-eight ^{67}Ga-citrate scans were evaluated in Hodgkin's and non-Hodgkin's lymphomas for staging, diagnosis of recurrence, and for determining the results of treatment. Accuracy as confirmed by comparing the scans with pathologic material or

roentgenologic and clinical findings was found to be 83%. Known lymph node involvement was diagnosed correctly in 87% but accuracy was only 48% for extranodal areas. Bone lesions were diagnosed correctly in 83% compared with only 48% of lesions of the lungs and liver. Scans were 75% accurate in 28 patients scanned for initial staging. False negatives were present in 12%; recurrent tumor in an area of prior radiation therapy appeared to be the most common cause. There were 5% false positives. Gallium scanning is a useful adjunct to other methods of detecting lymphoma. (auth)

30050 FORAMEN OF MORGAGNI HERNIA DIAGNOSED BY LIVER SCAN. Soucek, C. D. (Bethany Medical Center, Kansas City, KS). J. Nucl. Med.; 16: No. 4, 261-263(Apr 1975).

A case of foramen of Morgagni hernia (partial eventration of the right diaphragm) containing liver was diagnosed by hepatic scintiphotography. Diagnostic pneumoperitoneum has been recommended as the procedure of choice in the past. It is suggested that this be replaced by liver scanning. The similarity between eventration of the right diaphragm and foramen of Morgagni hernia is discussed. (auth)

30051 RAPID METHOD FOR EVALUATION OF REGIONAL CEREBRAL BLOOD FLOW AFTER INTRA-ARTERIAL INJECTION OF ^{133}Xe. Verbist, A.; Capon, A.; Fruehling, J. (Univ. Libre, Brussels). J. Nucl. Med.; 16: No. 4, 264-266(Apr 1975).

A technique based on the stochastic method is described for the computation of regional blood flow (RBF) after intra-arterial injection of ^{133}Xe. Results are presented on scintigrams, defined by 600 to 800 channels in a 64 × 64 matrix. The content of each channel is equal to the computed RBF value. The standard deviation is also computed for each channel. The total computation cycle is achieved within 10 min. The method has been used to investigate the influence of anesthesia or drugs on regional blood flow. For this purpose, a differential printout program was written in which variations of RBF values between the two measurements are expressed in units of a fixed percentage; provision is made for calculation of RBF variations in units of differential standard deviations. Data are in good accordance with other clinical findings. This method is suitable for clinical use when blood flow values in gray and white substances are not requested. (auth)

30052 LUNG SCAN AND WIDE MEDIASTINUM. Chandra, S.; Laor, Y. G. (Buffalo General Hospital, NY). J. Nucl. Med.; 16: No. 4, 324-325(Apr 1975).

A patient with dissecting aneurysm of the ascending aorta and hemopericardium showed a widened mediastinum on posterior lung scan. (auth)

30053 VISUALIZATION OF PANCREATIC PSEUDOCYST. Mattar, A. G.; Prezio, J. A. (Mercy Hospital, Buffalo). J. Nucl. Med.; 16: No. 4, 326-327(Apr 1975).

In a 44-year-old woman, a pancreatic pseudocyst was demonstrated on delayed images obtained up to 8 days after the intravenous administration of 0.250 mCi ^{75}Se-selenomethionine. The initial routine pancreas image study failed to visualize both the pancreas and the pancreatic pseudocyst. The diagnosis was confirmed at surgery and the fluid of the pancreatic pseudocyst contained 0.73% of the injected dose of the radioselenium. (auth)

30054 MULTIPLE PULMONARY ARTERIOVENOUS FISTULAS DEMONSTRATED BY DYNAMIC RADIONUCLIDE PULMONARY PERFUSION SCANNING. Snow, R. M.; Wilson, G. A. (Univ. of Rochester, NY). J. Nucl. Med.; 16: No. 4, 328-330(Apr 1975).

Dynamic radionuclide perfusion scintigraphy performed with ^{99m}Tc-labeled microspheres was instrumental in establishing the diagnosis of multiple, small-vessel, pulmonary arteriovenous fistulas in a 14-month-old patient with cyanosis. Computer analysis of the sequential distribution of tagged microspheres in the pulmonary parenchyma normally demonstrates a curve that rises rapidly to a plateau as the particles microembolize. In the case reported here, the pulmonary flow curve rose rapidly to a maximum and then fell within 2 sec to a plateau of less than 50% of the maximum count, indicating that a large proportion of the microspheres passed through the pulmonary circulation. Conventional pulmonary contrast angiography did not demonstrate any intracardiac shunting but did confirm the presence of multiple pulmonary arteriovenous fistulas. (auth)

30055 CISTERNOGRAPHIC IMAGING PATTERNS: EFFECTS OF PARTIAL EXTRA-ARACHNOID RADIOPHARMACEUTICAL INJECTION AND POSTINJECTION CSF LEAKAGE. Welch, D. M.; Coleman, R. E.; Siegel, B. A. (Washington Univ., St. Louis). J. Nucl. Med.; 16: No. 4, 267-269(Apr 1975).

A cisternographic pattern of subarachnoid block with transient or no ventricular radiopharmaceutical reflux was observed in 52% of 105 patients with partial extra-arachnoid injections or post-injection leakage of CSF or both at the lumbar puncture site. In several patients, adequate repeat studies demonstrated considerably different CSF flow patterns. This block pattern was seen in only 11% of 217 patients with adequate intrathecal injections. Lumbar CSF leakage may alter the pattern seen on a cisternographic study and, if present, the study should be interpreted with caution. (auth)

30056 DYNAMIC STUDY OF EXOCRINE FUNCTION OF THE PANCREAS IN DIABETES MELLITUS WITH SCINTIGRAPHY USING ^{75}Se-SELENOMETHIONINE. Goriya, Y.; Hoshi, M.; Etani, N.; Kimura, K.; Shichiri, M.; Shigeta, Y. (Osaka Univ.). J. Nucl. Med.; 16: No. 4, 270-274(Apr 1975).

A dynamic study of scintigraphy of the pancreas using ^{75}Se-selenomethionine in diabetic patients was performed. Patients were selected who complained of abdominal pain or diarrhea or both and whose pancreatic exocrine functions were thought to be disturbed. Selenium-75-selenomethionine (3 μCi/kg body weight) was injected intravenously and radioactivity (cpm) was recorded by a scinticamera for 10 min successively up to 120 min. After 20 to 30 min, the increase of radioactivity in the selected area of the displayed pancreas usually reached a plateau. Pancreozymin (1 Harper unit/kg) and secretin (1 Harper unit/kg) were administered intravenously and decrease of radioactivity in the same area was followed for 60 min to examine pancreatic exocrine function. After ^{75}Se-selenomethionine injection, the angle of the initial increase of radioactivity, the height of the plateau, and the reactive decrease of radioactivity after pancreozymin and secretin were analyzed in each case. Radioactivity recorded on data tape was reproduced for each 10-min period on a cathode-ray tube display. Areas of interest were selected for dynamic analyses. To supplement the diagnosis by visual image of a scintigram of the pancreas, the scintigram was quantified in the present study and the dynamic curves of radioactivity in the selected area of the displayed pancreas were studied for a total of 3 hr. Application of the dynamic study of the pancreas scintigraphy and the additional data analyses seemed useful for the early detection of pancreatic exocrine dysfunction in diabetic patients in whom the ordinary laboratory pancreatic exocrine function tests gave uncertain results. (auth)

30057 UPTAKE OF ^{99m}Tc BONE-SCANNING AGENT BY LUNGS WITH METASTATIC CALCIFICATION. McLaughlin, A. F. (Royal Prince Alfred Hospital, Camperdown, Australia). J. Nucl. Med.; 16: No. 4, 322-323(Apr 1975).

Uptake of ^{99m}Tc bone-scanning agent into lungs containing metastatic calcification was demonstrated in a patient with a carcinosarcoma of the bladder. This gives further support to the hypothesis that ^{99m}Tc bone-scanning agents are associated with hydroxyapatite. (auth)

30058 EVALUATION OF PORTABLE RADIONUCLIDE METHOD FOR MEASUREMENT OF LEFT VENTRICULAR EJECTION FRACTION AND CARDIAC OUTPUT. Berndt, T.; Alderman, E. L.; Wasnich, R.; Hsieh, S. C.; Van Dyke, D.; Harrison, D. C. (Stanford Univ., CA). J. Nucl. Med.; 16: No. 4, 289-292(Apr 1975).

Seventeen patients with coronary artery, valvular, or myopathic heart disease were studied to determine correlations of the cardiac output and ejection fraction when comparing the results obtained with a portable probe technique using ^{113m}In with those obtained with standard methods (cineangiographic, Fick, and dye dilution). With ejection fractions ranging from 0.10 to 0.85, the coefficient of correlation was 0.90 when comparing cineangiographic and radionuclide techniques. Cardiac output determinations by the radionuclide technique also correlated well with standard methods ($r = 0.88$). The radionuclide method shows promise as an accurate, safe, and simple method in the evaluation of cardiac function at the bedside. (auth)

30059 BREAST SCINTIGRAPHY WITH ^{99m}Tc-PERTECHNETATE AND ^{67}Ga-CITRATE. Richman, S. D.; Brodey, P. A.; Frankel, R. S.; de Moss, E. V.; Tormey, D. C.; Johnston, G. S. (National Institutes of Health, Bethesda, Md.). J. Nucl. Med.; 16: No. 4, 293-299(Apr 1975).

Radionuclide breast scintigraphy was evaluated as a noninvasive tumor-localizing modality. Technetium-99m-pertechnetate ($^{99m}TcO_4$) demonstrated good correlation between malignancy and positive scintigraphy (88% accuracy in 16 cases of breast carcinoma). The high false-positive rate (29% of proven benign breast disease) limits the use of $^{99m}TcO_4$ as an aid to differential diagnosis. Gallium-67-citrate (^{67}Ga) is limited as a diagnostic adjunct (localizing in only five of ten breast malignancies). Refined techniques of positioning, shielding, gamma camera imaging, and computer assistance have helped in visualizing abnormal radionuclide accumulation. (auth)

30060 LOCULATION AS A CONTRAINDICTION TO INTRACAVITARY ^{32}P-CHROMIC PHOSPHATE THERAPY. Taylor, A. Jr.; Baily, N. A.; Halpern, S. E.; Ashburn, W. L. (Univ. of California, San Diego, La Jolla). J. Nucl. Med.; 16: No. 4, 318-319 (Apr 1975).

Loculation of instilled ^{99m}Tc-sulfur colloid solution in the peritoneal cavity was observed in a patient being considered for intracavitary therapy with ^{32}P-chromic phosphate. Since intracavitary instillation of a therapeutic dose of a radiopharmaceutical agent into a loculated space would risk therapeutic failure and tissue necrosis, prior instillation of a tracer nuclide is recommended to insure adequate dispersion before beginning such therapy. (auth)

30061 AUTORADIOGRAPHY OF LIVE AND DEAD MAMMALIAN CELLS WITH ^{99m}Tc-TETRACYCLINE. Dewanjee, M. K. (New England Medical Center, Boston). J. Nucl. Med.; 16: No. 4, 315-317(Apr 1975).

Considering the diagnostic significance of a few ^{99m}Tc-chelates in the diagnosis of myocardial infarct, a necrosis model was developed in tissue culture obtained from mammalian cells, where the dead cells showed enhanced binding of ^{99m}Tc-tetracycline like the necrotic cells of infarcted myocardium. Technical details of the principles of labeling, fixing, washing and drying, dipping in emulsion, exposure, development, and staining of mammalian cells are described. Considering the short half-life of ^{99m}Tc-radioisotope, the recently available techniques were modified to make autoradiography possible in a reasonably short period of time. Technetium-99m in different physical and chemical states is playing a very important role in a variety of diagnostic procedures. The autoradiography of ^{99m}Tc-labeled cells and tissue will shed further light on the mechanism of cellular uptake and subcellular distribution in normal and pathologic states. Presently no information is available regarding autoradiography with ^{99m}Tc-chelates of mammalian cells obtained from tissue culture. (auth)

30062 NOMOGRAM FOR ESTIMATING NORMAL LIVER WEIGHTS. Eldridge, J. E.; Capurro, P. U. (Union Hospital of Cecil County, Elkton, MD). J. Nucl. Med.; 16: No. 4, 314(Apr 1975).

A nomogram was constructed by which the normal weight of a patient's liver can be estimated from the patient's height and weight. (auth)

30063 RADIOIMMUNOASSAY FOR HUMAN ANTIGEN-ANTIBODY COMPLEXES IN CLINICAL MATERIAL. Cowdery, J. S. Jr.; Treadwell, P. E.; Fritz, R. B. (Emory Univ., Atlanta). J. Immunol.; 114: No. 1, 5-9(Jan 1975).

Soluble antigen-antibody complexes have been detected by a radioimmunoassay with rheumatoid factor as the primary antibody to bind ^{125}I immune complexes or heat aggregated IgG. Bound complexes are precipitated by rabbit anti-human IgM. The binding of the rheumatoid factor to the iodinated altered IgG can be inhibited by preincubation of the rheumatoid factor with human antigen-antibody complexes. The degree to which immune complexes inhibit the binding of rheumatoid factor to heat aggregated IgG has been shown to be dependent upon the antigen-antibody ratio of the complexes, with complexes formed at or near the point of equivalence exhibiting maximum inhibitory activity. Sera from individuals suffering from certain connective tissue disorders were found to inhibit the binding of rheumatoid factor to ^{125}I aggregated IgG; sera from normal individuals did not inhibit this reaction when used at comparable dilutions. This procedure can be used as a relatively simple, reproducible means of detecting immune complexes in clinical specimens. The assay is sufficiently sensitive to detect 125 ng of soluble immune complexes. (auth)

30064 INTRARENAL BLOOD FLOW IN CHILDREN WITH NORMAL KIDNEYS AND CONGENITAL HEART DISEASE: CHANGES ATTRIBUTABLE TO ANGIOGRAPHY. Gruskin, A. B.; Auerbach, V. H.; Black, I. F. S. (Temple Univ., Philadelphia). Pediat. Res.; 8: 561-572(May 1974).

Thirty ^{133}Xe determinations of renal blood flow were made in 20 children ranging in age from $^{16}/_{12}$ to $10^{9}/_{12}$ years. In six normal kidneys, average blood flows to the outer and inner cortex were 374 and 44 ml/min/100 g, respectively. Mean fractional flows to these areas were 84 and 15 ml/min/100 g, respectively. In nine children with congenital heart disease (CHD) who were not in congestive heart failure and who were evaluated before angiography, a defect in outer cortical flow was demonstrated. Average blood flows to the outer and inner cortex were 250 ml/min/100 g (P 0.0005) and 27 ml/min/100 g (P 0.22). Mean fractional flows were 76% (P 0.03) and 24% (P 0.015), respectively. After cardiac angiography, a decrease in outer cortical flow occurred. The second flow study was performed 8–30 min after injection of contrast media (Hypaque-M, 75%) in amounts which ranged from 1.2 to 3.5 ml/kg body wt. After angiography, blood flows to the outer and inner cortex were 186 ml/min/100 g (P 0.001) and 24.5 ml/min/100 g (P 0.68). Average fractional flow to the outer, 74% and inner 26% cortex did not change (P 0.71). (auth)

30065 PROBLEMS ARISING FROM THE USE OF RADIOISOTOPES IN MEDICINE. Dermentzoglou, F. (Saint Savas Hospital, Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

Use of ^{87m}Sr, ^{99m}Tc-pyrophosphate, and ^{99m}Tc-HEDSPA for scintigraphic studies is discussed. (LK)

30066 PROBLEMS ARISING FROM THE USE OF RADIOISOTOPES IN MEDICINE. Kostamis, P. (Alexandra Hospital, Athens). pp 93-102 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

The most popular diagnostic procedures, with special emphasis on the magnitude of the radiation dose recieved, are discussed. Liver, renal, bone and brain scanning agents; agents for thyroid studies, lung studies, and pancreas studies are considered. (LK)

30067 MODEL FOR ULTRACENTRIFUGAL QUANTIFICATION OF [^{35}S]BROMOSULPHTHALEIN-BINDING TO PLASMA PROTEINS IN THE PRESENCE OF RADIOIMPURITIES. Vancura, S. J.; Clarenburg, R. (Kansas State Univ., Manhattan). Proc. Soc. Exp. Biol. Med.; 148: No. 3, 720-724(Mar 1975).

Solutions of [^{35}S]bromosulphthalein ([^{35}S]BSP) in heparinized canine plasma, in the proportions established in vivo after injecting BSP intravenously to test liver function, were ultracentrifuged at 226,000 g for 24 hr at 5°C. Protein-free supernatant was replaced by Krebs-Ringer buffer (pH 7.40), the protein sediment resuspended, and the mixture recentrifuged. That process was repeated several times, and the radioactivity of each resulting supernatant was measured. Since [^{35}S]BSP could not be adequately purified, supernatant radioactivities reflected both [^{35}S]BSP and radioimpurity. Therefore, a model was derived that interpreted the rapid decrease in supernatant radioactivities of initial centrifugations and the gradual fall thereafter; and allowed picomoles of non-protein-bound [^{35}S]BSP to be determined. Results indicated that only 0.053% (SD 0.0013%) of BSP in our system was not protein-bound. (auth)

30068 RADIOIMMUNOASSAY OF HUMAN JEJUNAL IgA SECRETION. Beeken, W. L.; Roessner, K. D. (Univ. of Vermont, Burlington). Proc. Soc. Exp. Biol. Med.; 148: No. 3, 739-742(Mar 1975).

To make quantitative determination of human IgA secretion by intestinal mucosa, a radioimmunoassay technique using ^{14}C was developed applicable to organ culture of jejunal biopsies. The technique permits accurate measurements with 4 to 8 jejunal biopsies, a number that can be obtained with acceptable safety. The 24 hr culture system minimizes the impact of the initial lag period in protein secretion observed by others. The technique provides a sensitive method for studying human IgA secretion under a variety of conditions. (HLW)

30069 USE OF ^{51}Cr FOR SHEEP RED BLOOD CELL SURVIVAL STUDIES. Giles, R. C. Jr.; Berman, A.; Hildebrandt, P. K.; McCaffrey, R. P. (Walter Reed Army Inst. of Research, Washington, DC). Proc. Soc. Exp. Biol. Med.; 148: No. 3, 795-798(Mar 1975).

The red blood cell half-life as determined by ^{51}Cr-labelled autologous cells in five adult sheep was 13.7 days. In contrast, the red blood cell life span measured by cohort ^{59}Fe-labelling in six adult sheep was 111.7 days. The rapid loss of ^{51}Cr-activity from the circulation appears to result from rapid elution of the label from the circulating red cells. ^{51}Cr does not appear to be a suitable isotope for erythrokinetic studies in sheep. (auth)

30070 RADIOIMMUNOASSAY FOR GH-RELEASE INHIBITING HORMONE. Arimura, A.; Sato, H.; Coy, D. H.; Schally, A. V. (Tulane Univ., New Orleans). Proc. Soc. Exp. Biol. Med.; 148: No. 3, 784-789(Mar 1975).

The synthetic growth hormone release inhibiting hormone (GH-RIH) was conjugated with human serum globulin using glutaraldehyde and administered to rabbits. An antiserum thus generated bound 70% of ^{125}I-Tyr-GH-RIH. The binding was inhibited by unlabelled GH-RIH and the inhibition was dose-related, enabling us to establish a radioimmunoassay method for GH-RIH. The minimum detectable dose was 4 pg. A linearity was demonstrated for immunoreactive GH-RIH of extracts of rat and pig hypothalami, indicating that they contained substance(s) indistinguishable from GH-RIH. Various hypothalamic and pituitary hormones did not interfere with the radioimmunoassay, but considerable cross-reaction was observed for linear GH-RIH

and the ring portion of GH-RIH, suggesting that the antigenic determinant involved the amino acid sequence from position 3 to 14 of GH-RIH or part of it. Plasma protein appears to contain substance(s) immunologically indistinguishable from GH-RIH or to interfere, in a nonspecific manner, with the radioimmunoassay system for GH-RIH. (auth)

30071 THE CLINICAL EVALUATION OF ^{99}Tc-PYROPHOSPHATE SCINTIGRAPHY FOR SKELETAL DISEASES. Masumi, S.; Yamamoto, M.; Murata, M.; Aritomi, H.; Ishii, K. (Kitasato Univ. (Japan). School of Medicine). Seikei Geka; 23: No. 1, 18-24(Jun 1974). (In Japanese).

Eighty six cases of several kinds of bone and joint diseases were scanned with ^{99m}Tc-pyrophosphate as bone imaging agent, and evaluated in comparison with clinical and radiological findings. These include 9 cases of inflammatory disease of bone, 5 cases of rheumatoid arthritis, 11 cases of osteoarthritis of knee, 8 cases of avascular femoral head necrosis, 15 cases of primary bone tumor (benign 10 and malignant 5), 32 patients with cancer and 6 cases of the other diseases. Using a dual 5 in. whole-body scanner and a gamma camera, bone scans were carried out routinely 3 to 5 hours after intravenous administration of 5 to 10 mCi of ^{99m}Tc-pyrophosphate. The image obtained with ^{99m}Tc-pyrophosphate is more sensitive and effective than those of ^{85}Sr, ^{87m}Sr, and ^{18}F. High concentration of tracer was more clearly demonstrated in the presence of abnormal x-ray views as inflammatory disease, bone necrosis, degenerative joint disease and malignant bone tumor. However, even with little or no evidence from x-ray views, abnormal uptake of ^{99m}Tc could early represent the existence of bone involvement and its extent. With ^{99m}Tc-bone scanning, the beneficial informations were obtained in early diagnosis, activity or process of the disease. (auth)

30072 RADIOIMMUNOASSAY OF HUMAN PROINSULIN C-PEPTIDE USING SYNTHETIC HUMAN CONNECTING PEPTIDE. Kaneko, T.; Oka, H.; Munemura, M.; Oda, T.; Yamashita, K. (Tokyo Univ. (Japan). Faculty of Medicine). Endocrinol. Jap.; 21: No. 2, 141-145(Apr 1974).

Radioimmunoassay of human C-peptide was established using antiserum to synthetic human connecting peptide and synthetic tyrosylated human connecting peptide. Synthetic human connecting peptide and natural human C-peptide showed the same degree of cross-reactivity with the synthetic human connecting peptide antiserum. Natural human proinsulin reacted approximately one fourth as well as the human connecting peptide or natural human C-peptide when expressed on an equimolar basis. Synthetic porcine and bovine connecting peptide, human insulin and natural porcine proinsulin did not react with the human connecting peptide antiserum. Synthetic human connecting peptide did not cross with insulin antiserum. The sensitivity of the radioimmunoassay was 0.05 ng/tube. The assay system was available to determine C-peptide immunoreactivity in plasma, because proinsulin and proinsulin-like components had been reported to be very low in plasma. The fasting level of C-peptide immunoreactivity in plasma of normal subjects assayed by this system was 0.88 ± 0.21 ng/ml. (auth)

30073 SCINTIGRAM OF TUMOR. Yamazaki, T. (Tokyo Women's Medical Coll. (Japan)). Gendai No Shinryo.; 16: No. 5, 717-724(May 1974). (In Japanese).

Scintigraphy with ^{67}Ga-citrate was studied. ^{67}Ga-citrate was accumulated in malignant tumor and it was shown as a positive scan. Positive scan was seen in 54 of 57 cases (94%) with malignant tumor in the lung, all 28 cases with malignant lymphoma. In addition, scintigrams in the typical cases such as reticulosarcoma, pulmonary cancer, sarcoidosis and tuberculous lymphadenitis were also studied. The mechanism of the accumulation into tumor is discussed. ^{67}Ga-citrate was deposited not only into hepatoma but also into other hepatic tumors, so that it might be qualitatively insufficient to the differential diagnosis. On the other hand, since ^{75}Se-selenomethionine was almost deposited specifically into hepatoma except some sarcoma, it was qualitatively superior for the diagnosis. (JA)

30074 DEVELOPMENT OF THE THYROID GLAND IN A GOBY, CHAENOGOBIUS UROTAENIA. Histogenesis and Initiation of the Uptake of ^{131}I. Takagoshi, T. (Hokkaido Univ., Hakodate (Japan). Faculty of Fisheries). 24: No. 2, 59-62 (Jan 1974). (In Japanese).

The development of thyroid gland in a goby, Chaenogobius urotaenia, was examined histologically. The fertilized eggs required 18 to 19 days at about 15°C to hatch. The fry, just after hatching, were 5.4 to 5.5 mm in total length. The thyroid anlage developed as an evagination from the ventro-median floor of pharynx at 5 days after fertilization (2.3 mm embryo in total length). Many follicular lumina appeared in the anlage of thyroid gland of the embryo (3.6 to 3.7 mm in length) at 8 to 9 days after fertilization. The eosinophilic colloid material however was not seen in the thyroid gland at this stage. The follicular lumina were filled with colloid material about the time of hatching. Autoradiographs were obtained from an embryo kept for 1 hour or 3 hours in a solution containing 40 μCi/ml of ^{131}I. The silver grains were not observed in autoradiographs obtained from section of the anlage of thyroid gland in the embryo (3.2 to 3.3 mm in length) at 7 days after fertilization. The silver grains were found mainly over the follicular lumen and the cells in autoradiographs obtained from section of the embryo (3.6 to 3.7 mm in length) at 8 to 9 days after fertilization ^{131}I-bound protein, probably thyroglobulin, is synthesized in the thyroid gland of the embryo reaching 3.6 to 3.7 mm in length. Furthermore, there is a possibility that the thyroid cells resorb the ^{131}I-bound protein from the follicular lumen. (auth)

30075 THE RELATIONSHIP BETWEEN ALPHA-AMINO ISOBUTYRATE AND L-VALINE FOR THE SUZUKACILLIN FORMATION. Ooka, T.; Takeda, I. (Asahi Chemical Industry Co. Ltd., Tokyo (Japan). Technical Research Lab.). Agr. Biol. Chem. (Tokyo); 38: No. 1, 19-27(Jan 1974).

The formation of Suzukacillin A (SK-A), a peptide antibiotic containing α-amino isobutyric acid (α-AiB) as an unnatural amino acid component, was promoted with increased supply of α-AiB while alternatively affected by the supplied amounts of L-valine; promotively with its adequate amounts (0.05 ~ 0.2%) but inhibitorily with its excess amounts (0.5 ~ 1.0%). In incorporation tests with ^{14}C-labeled pyruvate or L-valine, the radioactivity was incorporated into SK-A and mainly into α-AiB of SK-A formed, where a quantitative dilution occurred in the coexistence of their cold preparations. This suggests that L-valine or its related metabolite is a precursor of α-AiB in the biosynthetic process. Also the same was the case in the incorporation test with ^{14}C-labeled α-keto isovalerate, which seemed likely to be less effective precursor than L-valine on the basis of the radioactivity incorporated into α-AiB of SK-A peptide. When L-valine-1-^{14}C or pyruvate-1-^{14}C was used as incorporation substrate, no radioactivity in α-AiB of SK-A formed was found, and thus in the biosynthetic process of α-AiB from L-valine, 1-C of L-valine molecule might be decarboxylated and ruled out of α-AiB molecule. From the results obtained at the tests with each of radioactive pyruvate, L-valine and α-AiB, concomitantly supplied with various amounts of cold α-AiB or L-valine, it was suggested that there may occur a certain competitive correlationship between α-AiB and L-valine in the mobilizing process to SK-A peptide synthesis. The role of L-valine played in the formation mechanism of SK-A peptide was signified and discussed and a presumptive scheme for the formation mechanism of SK-A peptide was tentatively presented. (auth)

30076 TRIGLYCERIDE SYNTHESIS IN FATTY LIVER BY AMINO ACID IMBALANCE. Ogura, M.; Katsunuma, E.; Takahashi, O. (Utsunomiya Univ. (Japan). Faculty of Agriculture). Agr. Biol. Chem. (Tokyo); 38: No. 1, 149-155(Jan 1974).

Lipogenesis in the fatty liver of rat, which was induced by feeding an amino acid imbalanced diet containing 8% casein supplemented with 0.3% DL-methionine, was studied by measuring the incorporation of glycerol-1-^{14}C, palmitate-1-^{14}C, citrate-1,5-^{14}C, pyruvate-1-^{14}C, and pyruvate-2-^{14}C into various lipid fractions and $^{14}CO_2$ during in vitro incubation of liver slices. The total radioactivity of liver lipid per 100 g of the body and the incorporation of each substrate into triglyceride in the lipid were significantly higher in the imbalance group than the control group. Conversion of each substrate to $^{14}CO_2$ was not impaired in the imbalance group. Induction of this type of fatty liver is due mainly to the triglyceride synthesis by both the fatty acid synthesis and the transesterification of fatty acid. These results are considered to support the previous assumption (Agr. Biol. Chem., 36, 1159, (1972)) in which acetate-1-^{14}C was used as a precursor. (auth)

30077 NEUROSECRETION. Ishida, A. (Juntendo Univ., Tokyo (Japan)). 24: No. 4, 158-174(Aug 1973). (In Japanese).

Neurosecretion is discussed mainly by paying attention to the secretion mechanism at terminals. The neurosecretion neurone composing neurosecretion system is explained according to its components, such as neurosecretion cells, axis-code and terminal. In the neurosecretion cells, secretion is produced, and these cells also accept stimulus from neighboring cells. The axis-code is neuro secretory canal, and conducts nervous impulses that control secretion. The terminal is regarded as a portion to store and release materials. The secretion mechanism at the terminal is explained in detail according to the study of ^{45}Ca movement in the neurosecretion neurone terminal using electron-microscopic autoradiograms. (JA)

30078 STUDY ON DISTRIBUTION OF RADIOISOTOPE-LABELLED ANTIBIOTICS IN THE BODY, 2. Concentration of

Various Radioisotope-Labelled Antibiotics in Blood and Tissue Levels. Ito, Hiromu (Aichi-Gakuin Univ., Nagoya (Japan). School of Dentistry). Nippon Kyobu Geka Gakkai Zasshi; 19: No. 6, 583-596(Dec 1973). (In Japanese).

In application of liquid scintillation counting by the solubilization method, experiments were performed on the intramaxillary transfer of 7 RI-labeled antibiotics, ^{14}C-benzyle penicillin (^{14}C-PC), ^{3}H-lincomycin (^{3}H-LCM), ^{14}C-chloramphenicol, ^{3}H-tetracycline (^{3}H-TC), ^{3}H-kanamycin (^{3}H-KM), ^{3}H-cephaloridin (^{3}H-CER), and ^{3}H-erythromycin (^{3}H-EM), on systemic administration to mice. Their transfer into organ tissues such as the brain, tongue, and liver, was also studied. The intraorganic transfer speed of the RI-labeled antibiotics to reach the maximum concentration was the highest by ^{14}C-PC, followed by ^{14}C-CP and then ^{3}H-CER, slightly low by ^{3}H-LCM and ^{3}H-EM, and the lowest by ^{3}H-TC. The intramaxillary transfer rate of the RIs was in order of ^{3}H-LCM, ^{3}H-EM, ^{14}C-CP, ^{3}H-KM, ^{3}H-CER, ^{3}H-TC, and ^{14}C-PC-G. The order of the transfer rate to other organs than the maxilla was tabulated. Regarding the relationship between the intraorganic level and the blood level, the former exceeded the latter in ^{14}C-PC, ^{3}H-EM, ^{14}C-CP, ^{3}H-LCM, and ^{3}H-TC, and was lower than the latter in ^{3}H-CER. This indicates that the relationship between the distribution level of RI-labeled antibiotics in the blood and organs and speed differs individually, suggesting reciprocal selectivity and specific affinity between the RI-labeled antibiotics and each tissue. (JA)

30079 STUDY ON DISTRIBUTION OF RADIOISOTOPE-LABELLED ANTIBIOTICS IN THE BODY, 1. Determination of Radioisotope-Labelled Antibiotics in Biological Samples by Means of the Liquid Scintillation Counter. Ito, H. (Aichi-Gakuin Univ., Nagoya (Japan). School of Dentistry). Nippon Kyobu Geka Gakkai Zasshi; 19: No. 6, 577-582(Dec 1973). (In Japanese).

Antibiotics frequently used in clinical practice were labeled with ^{3}H and ^{14}C, and in the studies of their in vivo distribution, an attempt was made to determine whether or not liquid scintillation counting and the solubilization method were suitable. The counting efficiency was examined for a scintillamin OH solution, a toluene scintillator solution, and labeled-antibiotic solutions, with ^{3}H-lincomycin and ^{14}C-enzyl penicillin as reagents for preliminary experiments. For reducing chemical quenching phenomenon and yet performing accurate measurements, the volume of aqueous solution of ^{3}H-lincomycin and ^{14}C-benzyl penicillin to be administered to animals should be 0.5 ml, the volume of scintillamin OH, a histolytic adjunct, 1 ml, and toluene scintillator for measurement 7 ml. By this method of treatment, the counting efficiency of ^{3}H-lincomycin was 37.5% and that of ^{14}C-benzyl penicillin, 65%. The solubilization method with scintillamin OH solution is usable for experiments on the in vivo distribution of antibiotics using liquid scintillation counting apparatus. Based on the above preliminary experiments, the weight of tissues for addition was examined. Although the counting efficiency was the highest with 50 mg of tissues and 0.2 ml of blood, in terms of the amount of optimal treatment in the toluene system, a decrease in the counting efficiency was slight even in the case of 100 mg of tissues and 0.4 ml of blood with which the merit value reached a maximum. Calculation of the concentration in tissues and blood was obtained by the formula: amount of known RI-labeled antibiotic x cpm per g of excised organ (blood)/cpm per g of added sample. For liquid scintillation counting by the solubilization method, 100 mg of tissues and 0.4 ml of blood are dissolved by heating in a waterbath at 55°C for 24 hours using 1 ml of scintillamin OH, and the solution is decolorized with 30% hydrogen peroxide for counting with 7 ml of a toluene group scintillator. (JA)

30080 ADRENAL SCANNING WITH ^{131}I-19-CHOLESTEROL. Nakamura, M.; Sawai, Y.; Fukuchi, F.; Nakajima, Y. (Tohoku Univ., Sendai (Japan). School of Medicine). Gendai No Shinryo.; 16: No. 5, 701-705(May 1974). (In Japanese).

Scanning of adrenal glands was done with ^{131}I-19-cholesterol, and uptake ratio in both adrenal glands was calculated. Uptake ratio was 1.0 to 2.0 with an average of 1.34 in the patients with Cushing's syndrome due to hyperplasia, and 1.33 to 4.0 with an average of 3.33 in the patients with primary aldosteronism due to adenoma. This ratio became high in the patients with Cushing's syndrome due to adenoma and pheochromocytoma, because the uptake of the other side of the adrenal glands was inhibited. Adrenal scanning was a useful method to know the localization of adrenal tumor. (JA)

30081 SCINTIGRAM OF BONES. On Scintigrams with ^{99m}Tc-Pyrophosphate and ^{99m}Tc-Diphosphonate. Kawana, M. (Chiba Univ. (Japan). School of Medicine). Gendai No Shinryo.; 16: No. 5, 707-714(May 1974). (In Japanese).

Bone scanning with ^{99m}Tc-pyrophosphate and ^{99m}Tc-diphosphonate is described. Physical properties of ^{99m}Tc, the method of labeling, and the apparatus of measurement are generally discussed. Since bone scanning was begun using ^{99m}Tc-phosphatic compounds, 37 cases with ^{99m}Tc-polyphosphate, 110 cases with ^{99m}Tc-pyrophosphate, and 109 cases with ^{99m}Tc-diphosphonate were carried out. There were 7 cases with bone tumors, 13 cases with osteomyelitis, 11 cases with spinal caries, 10 cases with arthropathy and 4 cases with bone fracture, by diseases. There were many cases with metastatic bone tumors because bone scanning was performed mainly for the purpose of detecting bone metastases in cases with malignant tumor. (JA)

30082 PRESENT STATUS OF NUCLEAR MEDICINE IN JAPAN (1972), 2. In Vitro Tests. Kakehi, H.; Akiba, H. (Chiba Univ. (Japan). School of Medicine). Radioisotopes (Tokyo); 22: No. 9, 534-538(Sep 1973). (In Japanese).

Based on questionnaires in 1972, conditions of nuclear medicine in Japan, especially in vitro test such as test of thyroid gland functions, were described. Questionnaires were sent out to 838 facilities including hospitals and clinics where isotopes were employed for medical examination, and 565 answers were collected. The total number of in vitro tests carried out for a month in the facilities that answered the questionnaires was 74,478. However, the real number was presumed to be about 110,000, considering the number of uncollected questionnaires. In thyroid gland function tests (T_3, T_4, ETR and HTSH), T_3 test was performed in 423 facilities (96%). Insulin radioimmunoassay was performed in 135 facilities (30.7%) and the total number of the cases during a month was 18,159 (30.7%). The human growth hormone radioimmunoassay was performed in 67 facilities (15.2%) and α-feto protein was performed in 26 facilities (5.9%). Unsaturated iron binding capacity and renin activity radioimmunoassay were also performed. Although these examinations revealed the conditions in July 1972, the number will increase in the future. The tables show the number of cases for thyroid gland test and radioimmunoassay performed for one month by facilities including university hospitals and national hospitals. (JA)

30083 A DIFFERENTIAL DIAGNOSIS OF THE RENAL SCINTIGRAM. Suzaki, K.; Sakurai, T.; Moriya, H.; Hareyama, M. (National Hospital of Sapporo (Japan)); Tsutsuji, Y. Radioisotopes (Tokyo); 23: No. 3, 179-185(Mar 1974). (In Japanese).

Diagnostic approach was carried out in 92 cases with renal scintiscanning with ^{197}Hg-chlormerodrin. Differential diagnosis in space occupying lesions such as renal tumor, renal cyst, renal tuberculosis, and metastatic retroperitoneal tumor was clinically analyzed. These diseases might have no characteristic pattern on the scintigrams, but some characteristic pictures were obtained in many cases. In addition, the scintigrams of other renal diseases were mentioned. Diagnostic significance was observed in not only space occupying lesion, but also malformation, renal insufficiency and vascular diseases. As ^{197}Hg has low energy, it was safe in exposure dose, and there was no side effect. The scintigram is superior for resolution, and is applicable for diagnostic method. However, over-estimation on diagnosis using this method should not be made. (auth)

30084 DEVICE FOR CARRYING OUT SATURATION ANALYSES. (to Philips Gloeilampenfabrieken N.V.). Netherlands Patent 7,112,927. 21 Sep 1971. 13p. (In Dutch).

An extensive description is given of an apparatus for saturation analysis as is used in radioimmunoassay. It can be manufactured in different forms. The difference with existing apparatus is that the separation process via an absorbent column takes place before the chemical reaction. The reagents are premixed in the reaction vessel, therefore the equilibrium is reached quickly and accurately. Manipulation of radioactive material is reduced to a minimum. As an example triiodothyronine binding to serum protein is compared with the Trilute test. (NL)

MATERIALS

30085 (ILL-RA-1973(App.)) ANNEX TO THE ANNUAL REPORT, 1973. (Institut Max von Laue–Paul Langevin, 38–Grenoble (France)). 1973. 242p. (In Several Languages). Dep. NTIS (US Sales Only) $15.25.

The volume deals with the scientific work carried out at ILL during 1973 using the HFR (Grenoble), cold and hot neutron sources. Theory, nuclear physics, pure crystals, crystalline and magnetic structures, liquids, gases, amorphous substances, imperfections, biochemistry, and physical chemistry are subject areas covered. (FR)

30086 (TID/SNA-1280) REVIEW OF MATERIALS TECHNOLOGY FOR SOME NERVA APPLICATIONS. Freymeyer, R. D.; Rawe, R. A.; Urdea, M. G. (Space-General Corp., El Monte, Calif. (USA)). 13 Sep 1962. 149p. Dep. NTIS $10.50.

A literature survey was conducted to determine the current state of materials technology in respect to the environmental requirements for NERVA. The survey covered the areas of: (1) notch sensitivity of materials at cryogenic temperatures, (2) hydrogen embrittlement, (3) bearing materials and lubricants for operation at cryogenic temperatures and (4) ceramic electrical insulators applicable to the nuclear and thermal environments. In addition, a survey was made for materials which would sublimate within the temperature range of 500 to 1500°F. (79 references) (auth)

30087 THEORETICAL EQUATION FOR STEADY-STATE DISLOCATION CREEP IN A MATERIAL HAVING A THRESHOLD STRESS. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfield, Eng.). Proc. Roy. Soc. (London), Ser. A; 342: No. 1629, 279-287(25 Feb 1975).

A model of the dislocation creep process has been developed and shown to give reasonable predictions for the thermal and in-reactor creep rates of some pure crystalline materials. Its application to solid solutions has also been described and in the present paper the model is further developed for materials (such as those hardened by a dispersion) in which, arguably, dislocation creep only occurs when a threshold stress is exceeded. The predictions of the resultant creep equation are compared with the results of experiment and reasonable agreement is found. In particular the absolute rate of creep for a "SAP" type material is forecast with reasonable accuracy while the dependence of the stress and temperature sensitivity (of the creep rate) upon the absolute magnitudes of stress and temperature are correctly mirrored by the theoretical equation. (auth)

Ceramics and Cermets

Refer also to abstracts 29415, 30192, 30281, 31299, 31799, 31809, 31820, 31904, 32213, 32281–32283, 32292, and 32293.

30088 (AD/A-000027) THERMAL TRANSPORT IN REFRACTORY CARBIDES. Final Technical Report. Taylor, R. E.; Wu, K. Y.; Storms, E. K. (Purdue Univ., Lafayette, Ind. (USA)). 30 Jul 1974. 88p. (AFOSR-TR-74-1517). NTIS $4.75.

Thermal energy transport mechanisms in titanium carbide and zirconium carbide were studied. Several compositions of vanadium carbide alloyed with titanium carbide were used. The electronic component of the thermal conductivity exceeded the values computed using the classical value for L in the Wiedemann-Franz-Lorenz law. The results could be explained by allowing L to increase with increasing temperature. In the case of zirconium carbide, samples with various degrees of carbon vacancies were used. There was a remarkable increase in the electron and phonon contributions to the thermal conductivity as the carbon vacancy concentration was decreased near the stoichiometric composition. The temperature dependency of the thermal conductivity could be explained in terms of a substantial residual resistivity, and an L which increased with increasing temperature and which was somewhat dependent on the carbon vacancy concentration. (GRA)

30089 (AD/A-000195) CHEMICAL TECHNOLOGY OF CERAMICS AND REFRACTORY MATERIALS. Budnikov, P. 5 Jan 1974. Translated from pp 11-37; 115-139; 252-275; 286-331; 358-376; 547-548 of Khimicheskaya Tekhnologiya Keramiki i Ogneuporov, Moscow, 1972. (FSTC-HT-23-1280-73). 209p. NTIS $7.25.

Data are given on thermomechanical properties; physical properties; thermal properties; sintering and firing of ceramics; purposes of refractory materials and their classification; heat-insulating (lightweight) refractory materials; ceramics made of high-refractory oxides; ceramics based on silicates and aluminosilicates; ceramics based on infusible nonoxygen compounds; and cermets. Information is included on uranium oxides, zirconium oxides, beryllium oxides, and ThO_2. (GRA)

30090 (AED-CONF-74-571-002) IRRADIATION PERFORMANCE TEST OF PuO_2-UO_2 FUELS BY SAXTON REACTOR. Akutsu, H.; Koizumi, M. 1974. 39p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

17 figs.; 13 tabs.; 4 refs.; 15 photos. With abstract.

Mixed oxide (PuO_2-UO_2) fuel rods (four rods and one assembly containing 68 rods) were irradiated to certificate irradiation performance of prototyped fuel by Saxton reactor to peak burnups of up to 8050 MWd/Mtm. Linear power level was from 200 to 500 watts/cm. After irradiation, post-irradiation examinations were conducted in Battelle's Columbus Laboratories (BCL). The post-irradiation examinations consisted of visual examination, profilometry, gamma scanning, fuel and clad metallography, burnup analysis, hydride analysis in claddings, and clad strength tests. These examinations showed that the overall performance of the PuO_2-UO_2 fuel was satisfactory. (auth)

30091 (AED-CONF-74-571-007) IRRADIATION BEHAVIOUR OF LWR PLUTONIUM FUEL RODS. Bairiot, H.; Gaube, M.; van Outryve d'Ydewalle, B. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1974. 7p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

9 figs.; 3 tabs.; 3 refs. With abstract.

As the plutonium content in mixed oxide fuel for thermal reactors is relatively small, only limited changes are expected in their behavior as compared with uranium fuels. This assumption is being confirmed by experiments initiated by BELGONUCLEAIRE ten years ago on mixed oxide fuels, first with stainless steel cladding and later on with Zircaloy cladding. The confidence is continuously being built up through the good behavior of more than 990 rods irradiated in various power reactors (BR 3, DODEWAARD, GARIGLIANO). About 40 irradiation experiments in the BR 2 reactor were launched to further knowledge. (auth)

30092 (AED-CONF-74-571-019) EXPERIENCE IN FABRICATION OF LWR RECYCLE FUEL. Lins, W.; Schneider, V. W. 1974. 9p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

2 figs.; 1 ref. With abstract.

Since 1968 ALKEM has fabricated more than 10 tons of plutonium-containing fuel for LWRs. The fuel is pelletized, produced by the established process for UO_2 fuel as applied by NUKEM/RBU. Plutonium is introduced by mechanical blending of 1 to 5% PuO_2 and 95 to 99% UO_2 powder. The fabrication process has been developed from lab scale to an automated production line, which is now in operation for LWR mixed oxide fuel. Experience gained with the adaption of the known UO_2-fuel technique to mixed oxide fuel and with the transition from lab scale to automated fabrication is described. (auth)

30093 (ANL-8122) CHEMICAL ENGINEERING DIVISION, FUELS AND MATERIALS CHEMISTRY ANNUAL REPORT, JULY 1973–JUNE 1974. Johnson, C. E.; Dudey, N. D.; Heinrich, R. R.; Blackburn, P. E.; Fluss, M. J.; Greenwood, L. R.; Johnson, I.; Malewicki, R. L.; Popek, R. J.; Seils, C. A.; Staahl, G.; Steidl, D. V.; Tetenbaum, M.; Wach, C. G.; Cafasso, F. A.; Burris, L. (Argonne National Lab., Ill. (USA)). Jan 1975. Contract W-31-109-Eng-38. 97p. AT.

To aid in evaluating the performance of fast-breeder reactor fuels, high-temperature transpiration studies have been made of oxygen potentials over the U–Pu–O system at 2150 to 2550°K and where Pu/(U + Pu) = 0.2. A computer model was written to determine the redistribution of oxygen, uranium, and plutonium in irradiated fuels as a function of time and at steady state. Oxygen movement is controlled by ionic diffusion. Studies of the vaporization behavior of solid and liquid cesium molybdate have been carried out. The existence of gaseous cesium molybdate molecules as the principal species in the vapor has been established. Percolation theory has been applied to the study of oxygen diffusion in porous hyperstoichiometric urania pellets. Results of electron probe and ion microprobe analysis for actinide and fission-product redistribution are presented. Ion microprobe analyses of irradiated cladding have pointed to locations of the onset of cladding attack. A mechanistic model is presented to explain the migration of cesium and molybdenum in irradiated fuel pins. The Dosimetry and Damage Analysis Center (DADAC) was formed to provide coordinated and standardized methodology for translating fast-neutron dosimetry data into parameters that correlate with irra-

diation effects observed in controlled thermonuclear research (CTR) programs. Characterization in terms of neutron flux, fluence, and spectral distribution of several CTR experiments on irradiation effects is presented. The developmental progress of a ^{10}B-loaded liquid scintillation detector for the purpose of detecting neutrons of an intensity equal to the ambient neutron background is described. Dosimetry techniques, such as foil activation and solid-state track recorders (SSTRs), are being developed for the purpose of improving the accuracy of fission-rate measurements. Results of fission-rate measurements by these two methods are compared with results obtained from fission chambers in the same irradiation. (auth)

30094 (CEA-CONF-2808) DIRECT INFRARED MEASUREMENTS OF FILAMENT TRANSIENT TEMPERATURE DURING SWITCHING IN VANADIUM OXIDE FILM DEVICES. Duchene, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 29 May 1974. 14p. (CONF-740541-2). Dep. NTIS (US Sales Only) $4.00.

From international symposium on electronic properties of oxides and science applications; West Lafayette, Indiana, USA (29 May 1974).

The key parameter of the filament formation in VO_2 devices is the existence of an electrical discontinuity with temperature. The steepness of this discontinuity gives a large filament overheating before any appreciable thermal diffusion. The problem of the overheating effect must be solved for practical thermal switching devices. Destruction of VO_2 devices, even when the final steady-state temperature was as low as 100°C in the filament, were often observed. (auth)

30095 (CRNL-1226) DEVELOPMENT PROGRAM FOR A PLUTONIUM FUELLED CANDU REACTOR. McEwan, J. R.; Jeffs, A. T. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1974. 8p. (AED-CONF-74-571-022). INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

3 figs.; 2 tabs. With abstract. Available from ZAED.

A decision was made in 1970 to construct a small pilot facility to fabricate $UO_2 + PuO_2$ fuel bundles. The objectives were to gain sufficient experience in plutonium fuel fabrication that reliable fuel fabrication costs could be generated and to demonstrate the successful operation of mixed oxide fuel bundles in Canadian Power Reactors. This report describes the plutonium pilot plant and outlines the first phases of the irradiation program. (auth)

30096 (DPST-75-128-1) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jan 1975. Contract AT(07-2)-1. 49p. Dep. NTIS $5.50.

Investigation continued of variations in sinterability of SRP $^{238}PuO_2$ feed. The following were observed: (1) Small pellets hot-pressed to fixed volume with PPO process parameters were within PPO specification (82.5 ± 2% theoretical density) and did not exhibit large variations in sinterability observed at LASL for higher (90%) density LCHP (low cost, high performance) pellets. (2) The average particle size of $^{238}PuO_2$ at SRP decreased generally. (3) Particle sizes of specific $^{238}PuO_2$ lots do not correlate with high sinterability in LASL tests. (4) As shown in studies with the scanning electron microscope, variations among $^{238}PuO_2$ lots are introduced during precipitation of plutonium oxalate and are not significantly affected by variations in calcining temperature. Lubricant absorbed during cold pressing should have no significant effect on fabricability or final purity of PPO spheres. (16 figs, 8 tables) (auth)

30097 (TID/SNA-286) REQUIREMENTS FOR TESTS OF EFFECTS OF GAMMA RADIATION ON ELECTRONICS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1972. 84p. Dep. NTIS $7.25.

Tests were conducted to indicate the feasibility of using radiation hardened, p-channel, enhancement-mode, metal-oxide-semiconductor (PMOS) power switching devices to meet NERVA valve actuator electronics requirements. This is one of a series of tests which is necessary to completely characterize the operation of PMOS power switches in the NERVA reactor radiation field under dynamic operating conditions. The combined effect of radiation and simulated NERVA electrical operating conditions on degradation of PMOS power switches in a gamma environment at ambient temperature was evaluated. The extent of degradation of the test units is used in establishing NERVA actuator circuit design criteria for hardened PMOS power switching devices with a confidence commensurate with NERVA program guidelines. (auth)

30098 ANELASTIC CREEP OF BORON FIBERS. Prewo, K. M. (United Aircraft Research Lab., East Hartford, CT). J. Compos. Mater.; 8: No. 4, 411-414(Oct 1974).

Boron, silicon carbide, and alumina fibers are used to give high specific strength and elastic modulus to aluminum, titanium, and nickel base alloy matrices. Boron fibers were shown to exhibit anelastic creep, a phenomenon in which a fiber, if constrained in a curved form and heated, will tend to retain that form. Boron fibers were wrapped around a mandrel and heated. The retained radius of the boron coil was found to decrease significantly with increasing forming temperature. SiC, Al_2O_3, and a carbon–boron alloy fiber showed no such creep characteristics. (PMA)

30099 FABRICATION OF CERAMIC FUEL PELLETS. (to Societe Belge pour l'Industrie Nucleaire). Netherlands Patent 7,204,722. 7 Apr 1972. 6p. (In Dutch).

The invention relates to an apparatus for the fabrication of ceramic fuel pellets. It is possible to avoid correcting the shape of the pellets after sintering by means of an improved system of pressing. (NL)

30100 ZIRCONIA RAMMING COMPOUND TESTED IN INDUCTION FURNACES. Karaulov, A. G.; Rudyak, I. N.; Grushevaya, T. F.; Palashenko, V. I. (Scientific-Research Inst. of Refractories, Kharkov). Refractories (USSR) (Engl. Transl.); 15: No. 3-4, 239-243(Jan 1975).

Translated from Ogneupory; 15: No. 4, 39-42(Apr 1974).

Trials were carried out with a ramming compound consisting of 80% zirconia partly stabilized in cubic form and 20% monoclinic zirconia binder activated by fine-grinding. The grain size distribution of the compound was 50% fraction 2-0.5 mm, 10% 0.5-0.09 mm, and 40% finer than 0.09 mm. This type of compound possesses adequate strength and high spalling resistance and is suitable for lining induction furnaces for heating billets to 2000-2300°C. It can also be used as heat insulation in other high-temperature equipment in which the medium used does not erode the lining. (auth)

30101 ZIRCONIA-BASED RAMMING COMPOUNDS WITH PHOSPHORIC ACID BINDER. Karaulov, A. G.; Grebenyuk, A. A.; Sudarkina, T. E.; Eltysheva, A. A.; Gul'ko, N. V.; Rekov, A. I.; Sukhov, V. N.; Il'in, V. A. (Scientific-Research Inst. for Refractories, Kharkov). Refractories (USSR) (Engl. Transl.); 15: No. 3-4, 194-198(1974).

Translated from Ogneupory; 15: No. 3, 55-60(Mar 1974).

Compositions were developed for low-shrinkage zirconia ramming compounds containing a phosphate binder. An investigation was carried out of the interaction of the orthophosphoric acid with the zirconia and the stabilizing additive, and of the proportion of acid as a factor in the strength of the rammed compounds and concretes. The rammed compounds and concretes were tested in the lining of high-temperature combustion chambers at temperatures above 2000°C. The results of the tests were favorable. (auth)

30102 SUPERCONDUCTIVITY OF SOLID NIOBIUM AND MOLYBDENUM MONOCARBIDE SOLUTIONS AND THE EFFECT ON IT OF HIGH HYDROSTATIC PRESSURE. Dubrovskaya, L. B.; Nazarova, S. Z. Zh. Eksp. Teor. Fiz.; 68: No. 1, 238-240(Jan 1975). (In Russian).

The superconductivity transition temperatures T_c are measured for $NbC_{1.0}$–$MoC_{0.67}$ solid solutions; T_c decreases monotonously from 11.56 K for $NbC_{1.0}$ down to 8.62 K for $(NbC)_{0.05}(MoC_{0.67})_{0.95}$. All preparations were subjected to thermal treatment in a high pressure chamber with the aim of increasing the carbon concentration in the lattice of the solid solution. Subsequent analyses and measurements of T_c after termination of pressure showed that the treatment did not increase the carbon content in the solid solution but did increase its T_c. (auth)

30103 OXYGEN PERMEABILITY OF SOLID ELECTROLYTES OF ZIRCONIUM DIOXIDE STABILIZED WITH THE OXIDES OF SCANDIUM AND CALCIUM. Gil'derman, V. K.; Neuimin, A. D.; Pal'guev, S. F. (Ural Scientific Center, Sverdlovsk, USSR). Dokl. Akad. Nauk SSSR; 218: No. 1, 133-136(1 Sep 1974). (In Russian).

The oxygen permeability constant and the oxygen diffusion coefficient were measured for ceramic samples of ZrO_2 containing 0.1% Sc_2O_3 or 0.15% CaO. The temperature dependence of these two parameters was shown. The number of hole transfers were calculated for these two electrolytes and for electrolytes with 0.1% Y_2O_3 and 0.08% Y_2O_3 + 0.03% Al_2O_3. (JSR)

30104 INFLUENCE OF ABRASIVE POLISHING ON THE STRESS STATE AND TOUGHNESS PROPERTIES OF CEMENTED CARBIDES. Snell, P. O.; Paernama, E. (Fagersta-Seco AB, Sweden). Planseeber. Pulvermet.; 21: No. 4, 271-280(Dec 1973).

A WC–Co alloy and a WC–TiC–TaC–NbC–Co alloy were mechanically polished and analyzed for residual stresses using x-ray diffraction line profiles. Toughness measurements, crack studies, and acoustic emission tests were also made. The results show that grinding introduces compressive stresses into the

carbide as well as into the cobalt phase. Removal of the disturbed surface layer by polishing decreases the compressive stresses to 25 kp/mm² in the carbide phase and to 15 kp/mm² in the cobalt phase. Accordingly, the polished surface can scarcely be considered to be in an undisturbed or "zero stress state" as far as the cobalt phase is concerned. (PMA)

30105 STRUCTURE OF PbU_2Se_5. Potel, M.; Brochu, R.; Padiou, J. (Univ., Rennes, France). Mater. Res. Bull.; 10: No. 3, 205-208(Mar 1975). (In French).

PbU_2Se_5 crystallizes in a monoclinic unit cell a = 8.605 Å; b = 7.788 Å; c = 12.27 Å; β = 90° of space group $P2_1/c$, Z = 4. The crystal structure has been determined for 1251 independent reflections and refined to a final R value of 0.068. Two kinds of uranium sites are found; the average U–Se distances are 2.97 Å for eight-coordination and 2.88 Å in seven-coordination. The average Pb–Se distance for eight-coordination is 3.20 Å. This structure explains the solid solution between PbU_2Se_5 and U_3Se_5. (auth)

30106 EVAPORATION OF SOLIDS BY LASER PULSES. II. ZIRCONIUM HYDRIDE. Olstad, R.A.; Olander, D.R. (Inorganic Materials Research Division, Lawrence Berkeley Laboratory, and Department of Nuclear Engineering, College of Engineering, University of California, Berkeley, California 94720). J. Appl. Phys. 46: No. 4, 1509-1518 (Apr 1975).

The vaporization of hydrogen from the binary solid compound zirconium hydride induced by pulses from a Q-switch ruby laser was studied using a quadrupole mass spectrometer. The rate of vaporization of H and H_2 during the rapid temperature transient was determined from the measured mass spectrometer signals. Application of an equilibrium model to the vaporization process predicts that predominantly H_2 (rather than H atoms) should be emitted. The vaporized hydrogen should have a Maxwellian velocity distribution characteristic of the instantaneous surface temperature, and the rates of vaporization should be related to the equilibrium H_2 and H pressures by the Langmuir equation. Since the equilibrium pressure is a function of both surface temperature and surface hydrogen concentration, it was necessary to solve simultaneously the time-dependent heat conduction and hydrogen diffusion equations in the heated zirconium hydride in order to predict the vaporization rates. It was found that H atoms and H_2 molecules were emitted at thermal equilibrium with the surface. At low laser power density, the magnitude of the H_2 signals agreed with the equilibrium model. At high laser power density, the magnitude of the H_2 signals was less than predicted, possibly because of a diffusion barrier at the surface. The H atom signals were much larger than predicted, indicating that they were produced by a nonequilibrium surface process which favored direct vaporization of adsorbed hydrogen atoms rather than recombination followed by H_2 desorption. (auth)

30107 HIGH-FIELD ELECTRON EMISSION FROM OXIDE–METAL COMPOSITE MATERIALS. Feeney, R.K.; Chapman, A.T.; Keener, B.A. (Schools of Electrical and Ceramic Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332). J. Appl. Phys. 46: No. 4, 1841-1843 (Apr 1975).

High-field electron emission from unidirectionally solidified oxide–metal composites has been experimentally evaluated. Multipin arrays with pin diameters of 0.2–1.0 μm and pin densities of (5–50) $\times 10^6$/cm² were produced in UO_2–W, ZrO_2–W, and Gd_2O_3–Mo systems. Macroscopic current densities in excess of 100 mA/cm² were routinely obtained and the observed emitter lifetime was in excess of 2000 h. (auth)

30108 HOLE MOBILITY AND TRANSPORT IN THIN SiO_2 FILMS. Hughes, R.C. (Sandia Laboratories, Albuquerque, New Mexico 87115). Appl. Phys. Lett. 26: No. 8, 436-438 (15 Apr 1975).

The first measurement of the hole mobility and its temperature dependence in thermally grown SiO_2 on Si is reported and found to follow $\mu \simeq 20 \exp(-0.6eV/kT)$ cm²/V sec. In agreement with previous studies, the energy required to form an electron–hole pair with ionizing radiation is found to be field dependent and at very high fields is in the range of 18 eV/electron–hole pair, and is nearly temperature independent from 77 to 370 °K. (auth)

30109 REPLY TO COMMENT BY LEITNAKER AND STIEGLER. Ashbee, K. H. G.; Frank, F. C. (Bristol Univ. (UK). H. H. Wills Physics Lab.). J. Nucl. Mater.; 55: No. 1, 116(Jan 1975).

Ashbee and Frank concede that their mechanism for producing "chemically induced voids" in boron carbide must be discarded (Ashbee et al., J. Nucl. Mater. 48 (1973) 193). The observed association of voids with precipitates needs to be explained. (auth)

30110 COMMENT ON ASHBEE ET AL.'S PAPER ON VOIDS IN BORON CARBIDE. Leitnaker, J. M.; Stiegler, J. O. (Oak Ridge National Lab., Tenn. (USA)). J. Nucl. Mater.; 55: No. 1, 113-116(Jan 1975).

Ashbee et al. have postulated an interesting mechanism for the formation of voids in boron carbide during preparation of pellets of this material. The proposed mechanism involves (1) removal of C from a $B_{13}C_2$ lattice via formation of Fe_3C, and (2) volume growth of the remaining $B_{13}C_2$ lattice. The formation mechanism of the "chemically induced voids", as Ashbee et al. term them, is certainly important to fabricators. But the particular mechanism proposed by Ashbee et al. cannot be correct. It is shown that Fe will not react with boron carbide to form Fe_3C in the composition range studied by Ashbee et al. The thermodynamic equations used, even appropriately modified, do not lead to the stated conclusion. By drawing the possible ternary phase diagram one can easily ask the correct question to decide whether or not the reaction postulated can occur. It is shown that data in the literature can be used to conclude that the postulated reactions do not occur, and the results of a simple experiment verifying the present thermodynamic calculations are reported. (auth)

30111 BIREFRINGENT AND ELECTRO-OPTICAL PROPERTIES OF IMPROPER FERROELECTRIC β-$Tb_2(MoO_4)_3$. Konak, C. (Inst. of Physics, Prague); Chapelle, J.; Matras, J. Phys. Status Solidi (b); 67: No. 1, K47-K50(1 Jan 1975).

The temperature dependencies of the spontaneous and the induced birefringence in terbium molybdate was studied. Results are discussed and presented in graphs of electrooptical coefficient vs temperature, and permittivity vs temperature. (JRD)

30112 ROLE OF A DOUBLE OXYGENOUS BRIDGE IN RADIATION-INDUCED CENTER FORMATIONS IN GLASSES FROM EPR DATA. Cherenda, N. G.; Yudin, D. M. (Inst. of Physics, Minsk). Phys. Status Solidi (b); 67: No. 1, 255-261(1 Jan 1975).

Experimental data for effects of various penetrating radiations on oxidic glasses and of changes in the isotopic composition of the glasses on induced electron paramagnetic resonance (EPR) spectra are presented. It is found that the interpretation of investigation data of radiation centers in irradiated glasses is inadequate. A mechanism of paramagnetic center formation which is different from an electron-hole mechanism and which allows to interpret the experimental data correctly is proposed. (auth)

30113 COMPARATIVE STUDY OF THE OXIDATION OF ZIRCONIUM, HAFNIUM AND TITANIUM DIBORIDES. Lebugle, A.; Montel, G. (Ecole Nationale Superieure de Chimie, 31–Toulouse (France)). Rev. Int. Hautes Temp. Refract.; 11: No. 3, 231-244(Jul 1974). (In French).

The oxidation of zirconium, hafnium and titanium diborides at temperatures lower than 750°C was studied on powdered samples in oxygen-argon atmosphere. The influence of the structure of the amorphous oxide layer on the oxidation phenomena was established. The oxidation processes are similar for the three diborides and depend on temperature. (FR)

30114 ELABORATION OF LANTHANIDE OXIDE SINGLE CRYSTALS BY VERNEUIL METHOD. Lejus, A. M.; Connan, J. P. (Ecole Nationale Superieure de Chimie, 75–Paris (France)). Rev. Int. Hautes Temp. Refract.; 11: No. 3, 215-217(Jul 1974). (In French).

Large single crystals of lanthanide oxides (La_2O_3 and Nd_2O_3 of A structure, Sm_2O_3 and Gd_2O_3 of B structure and Er_2O_3 of C structure) were prepared by the Verneuil method using an oxhydric torch. A description of the operating conditions is given and the resulting crystals are presented. (FR)

30115 A METHOD FOR FORMING COATINGS RETAINING FISSION PRODUCT AND NUCLEAR FUEL PARTICLES THUS OBTAINED. Lefevre, R. L. R. (to Commission of the European Communities, Luxembourg). French Patent 2,182,887/A/. 21 Mar 1973. 6p. (In French).

The procedure is characterized by the deposition, on a porous carbon layer surrounding the core of the pellet, of a thin layer of silicon carbide to fill the irregularities of the carbon surface layer. This deposit is covered by a finer layer of pyrolytic carbon and then by a thick layer of silicon carbide. The last layer can be coated by an external coating of pyrolytic carbon. Such a procedure is particularly convenient for forming UO_2 pellets designed for nuclear reactors. (tr-auth)

30116 IMPROVEMENTS TO THE METHODS FOR PREPARING CERAMICS OF FISSILE MATERIALS. Francois, B.; Gremeret, R. (to CEA, 75–Paris (France)). French Patent 2,188,614/F/. 5 Jun 1972. 14p. (In French).

A method is described for the manufacture of cermets and porous metal masses. Powder is compressed up to a pressure ranging from 5 to 9 tons/sq cm in order to provide granules of the desired sizes. The granules are then crushed and sifted, a second compression is carried out at a pressure ranging from 0.2 to 5 tons/sq cm, and finally a sintering operation is carried out at a temperature ranging from 1300 to 2000°C. The product thus obtained is used as nuclear fuel. (FR)

30117 HIGH-POROSITY CONDUCTIVE CERAMICS AND A METHOD FOR PREPARING SAME. Carbonnel, H.; Hamon, L. (to Groupement pour les Activites Atomiques et Avancees (GAAA),

92 – Le Plessis-Robinson (France)). French Patent 2,186,960/D/. 22 Dec 1971. 4p. (In French).

A description is given of a method for preparing a high porosity conductive ceramic material. The method involves the following steps: preparing a fine powder of di-boride of a metal belonging to the IVa, Va, or VIa groups of the periodic table of elements; sintering from 20 to 80% of the thus prepared fine powder under pressure and at a very high temperature (from 1000 to 2000°C), then crushing same; admixing the remaining fine powder with the granules resulting from that crushing operation; kneading the latter admixture together with from 1 to 6% of a fluoride of a metal belonging to the 1A and 1B groups of the periodic table; vibrating the mixture for a short time while in a mold; sintering the resulting mixture, while maintaining it at a temperature of from about 1000 to about 1500°C for one or several hours in an atmosphere of an inert gas, e.g., argon; and cooling the mixture. Such ceramics can be used in liquid metal pumps and in electrolytic devices. (FR)

30118 A METHOD FOR MANUFACTURING POROUS CERMETS FROM FISSILE MATERIAL MACRO-GRANULES. Delmas, R.; Fredric, J. P.; Francois, B.; Guibert, M. (to CEA, 75 – Paris (France)). French Patent 2,187,724/A/. 5 Jun 1972. 11p. (In French).

A method is described for the manufacture of porous cermets containing a fissile material, such as uranium oxide and plutonium oxide, and a metal. The method involves preparing granules of fissile material, coating these granules successively with a pore-generating material and a powdered metal, then sintering them. Porosity is adjusted by regulating the thickness of the MoO_3 layer while maintaining a constant amount of Mo in compliance with the desired oxide/metal ratio. Cermets are used as nuclear fuels. (FR)

30119 A METHOD FOR MANUFACTURING POROUS CERMETS FROM FISSILE PRODUCT MACRO-GRANULES. Delmas, R.; Francois, B.; Fredric, J. P.; Guibert, M. (to CEA, 75 – Paris (France)). French Patent 2,187,725/A/. 5 Jun 1972. 9p. (In French).

A method is described for the manufacture of porous cermets containing a fissile product, such as uranium oxide or plutonium oxide, and a metal. The method involves coating raw granules of a higher-oxide of the fissile product with a layer of a liquid containing an organic binder and a solvent and with a layer of a finely powdered metal, then sintering these granules. It is thus possible to prepare relatively porous cermet, the volumetric porosity of which can reach 20% for a UO_2/metal ratio of about $\frac{2}{3}$. The cermets are used as nuclear fuels. (FR)

30120 ELECTRIC CONDUCTIVITY AND STRUCTURE DEFECTS IN ThO_2 AT HIGH TEMPERATURE. 2. Study of Ionic and Electronic Conductivities. Hammou, A.; Deportes, C. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, 38 – Grenoble (France)). J. Chim. Phys.; 71: No. 7, 1071-1080(Jul 1974). (In French).

The ionic transport number, in thorium dioxide was determined by the emf method between 1065 and 1500°C and in the oxygen partial pressure range 1 to 10^{-20} atm. The variation curves of the ionic and electronic conductivities were established in function of the temperature and oxygen partial pressure, using the total conductivity values previously determined by the authors. All the experimental results are interpreted taking into account the presence of reducible impurities in the polycrystal. (FR)

30121 SOME PROPERTIES OF SINGLE CRYSTALS OF SAMARIUM OXIDE PREPARED BY THE VERNEUIL PROCESS. Lejus, A. M.; Collonges, R. (Centre National de la Recherche Scientifique, 94 – Vitry-sur-Seine (France). Centre d'Etudes de Chimie Metallurgique); Bernier, J. C. (Ecole Nationale Superieure de Chimie, 67 – Strasbourg (France)). Rev. Int. Hautes Temp. Refract.; 11: No. 3, 183-185(Jul 1974). (In French).

Single crystals of samarium oxide Sm_2O_3 with monoclinic B structure were prepared by the Verneuil process. Some properties of these crystals (cleavage, microhardness, magnetic properties, hydration, ...) are affected by the structural anisotropy (layered structure). (FR)

30122 ABSOLUTE THERMAL CONDUCTIVITY MEASUREMENT OF INSULATING MATERIALS. Liermann, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Bull. Inform. Sci. Tech. (Paris); No. 197, 45-50(Nov 1974). (In French).

The need to know the precise thermal conductivity of the low conductivity materials used for insulation at high temperature lead to the development of an apparatus for measuring the absolute value based on the guarded hot plate principle and using symmetrical specimens. This apparatus uses specimen 200 mm in diameter and 20 mm thick and allows measurements in vacuum or low pressure gas up to 1000°C. After a detailed description, the report concentrates on the precautions taken to eliminate thermal losses, obtain a uniform heat flux, and to obtain accurate temperature measurements. The apparatus allows measurement of the thermal conductivity of fibrous and ceramic materials between 100 and 1000°C. (FR)

30123 α-RECOIL DAMAGE IN ZIRCON. Vance, E. R. (Australian National Univ., Canberra). Radiat. Eff.; 24: No. 1, 1-6(1975).

The effect of α-recoil damage in natural zircon was studied by infrared spectra of the silicate vibrations, single crystal x-ray diffraction, and polarized visible and near infrared spectra of absorptions due to tetravalent uranium. Contrary to some previously expressed views, α-recoil damage in natural zircon appears to be a progressive process, with increasing α-recoil dosage. No crystalline phases of zirconia or silica were detected by x-ray diffraction and measurements of U^{4+} spectra, in any but some very severely damaged zircons. The end product, in the limit of very high α-recoil doses, would seem to be a glass, rather than a mixture of SiO_2 and ZrO_2. The Si-O bonding in the glass would appear to be rather similar to that in vitreous SiO_2. (auth)

30124 MODEL FOR IN-REACTOR DENSIFICATION OF UO_2. MacEwan, S. R.; Hastings, I. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phil. Mag.; 31: No. 1, 135-143(Jan 1975).

A model for the in-reactor densification of UO_2 at temperatures below about 1200°K was developed. The approach is based on the buildup of irradiation-produced point defects during a transient period and their annealing at sintering pores. At 900°K and 10^{19} fissions m^{-3} s^{-1}, the model shows that intragranular pores up to 0.2 μm diameter disappear in about 1 hour, those above 1 μm diameter take about 75 days. Agreement with existing results is reasonable. (auth)

30125 MOMENTUM AND SPIN DENSITY IN MAGNETITE. Mijnarends, P. E.; Singru, R. M. (Stichting Reactor Centrum Nederland, Petten). Appl. Phys.; 4: No. 4, 303-306(Aug 1974). 5 figs.; 13 refs.

Measurements are reported of the angular correlation of annihilation radiation from polarized positrons in single crystals of Fe_3O_4. No change has been found in the angular correlations on passing through the metal-nonmetal phase transition. The two-photon momentum distribution, obtained by deconvolution of a set of angular correlations, displays a slight anisotropy. The spin density consists of a negative peak at zero momentum surrounded by a shell of positive density between 2 and 5 mrad. The observed spin density is probably a mixture of contributions from the moment on the ferrous ions and from the spin transfer onto the anions owing to covalency effects. (auth)

30126 THEORETICAL FOUNDATION AND EXTENSION OF THE TRAPPING MODEL. Frank, W.; Seeger, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F.R. Germany). Inst. fuer Physik). Appl. Phys.; 3: No. 1, 61-66(Jan 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973). 1 fig.; 12 refs.

The trapping model frequently used for analyzing experiments on positron annihilation in solids is put on a firm theoretical basis by deriving it from Waite's theory of diffusion-limited reactions. The conventional version of the trapping model turns out to be correct only if the trapping process is not diffusion-limited and if the escape probability of positrons from traps is negligibly small. Detrapping and the effects of positron diffusion for an arbitrary number of different types of traps are analyzed, and a perturbation-theory solution for the general case is developed. (auth)

30127 ON THE PREPARATION AND THE LUMINESCENCE OF ANTISTOKES-PHOSPHORS OF Y_2O_3 AND La_2O_3 ACTIVATED BY ERBIUM. Grimmeiss, H. G.; Titze, H. (Lund Univ. (Sweden). Institutionen foer Fasta Tillstaendets Fysik). Z. Phys. Chem. (Frankfurt); 87: No. 4/6, 208-217(Dec 1973). (In German).

A simple method is described for the preparation of red light-emitting anti-stokes-phosphors based on Y_2O_3 and La_2O_3. In addition, the best doping concentrations are reported for simple oxides and mixed oxides which have been prepared by optimizing both the chemical procedure and the heat treatment. The most efficient phosphors have been obtained using lanthanum oxide doped with 8 atomic percent Yb and 5 atomic percent Er after 60 hours heat treatment in air. Yttrium oxide and all other mixed oxides show much smaller luminescence efficiencies. (auth)

30128 ELECTRON RADIATION EFFECTS ON TIME-DEPENDENT DIELECTRIC BREAKDOWN IN SiO_2 FILMS. Seung, P. L.; Maserjian, J. (California Inst. of Tech., Pasadena). Solid-State Electron.; 18: No. 3, 287-288(Mar 1975).

The ion-drift model in time-dependent dielectric breakdown and the model of radiation-induced charge trapping in MOS structures are found to be mutually consistent. It is shown that positive charge

is trapped near the metal of a MOS capacitor following irradiation, decreasing the effective field at the metal interface applied during dielectric breakdown measurements, resulting in partial inhibiting of the Schottky and Poole–Frenkel emission of sodium ions from the metal interface and hence lower probabilities of breakdown. (UK)

30129 THERMODYNAMIC PROPERTIES OF ZIRCONIUM OXIDES. Vasil'eva, L. A.; Granovskaya, Zh. V. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 6, 902-904 (Jun 1974).

Translated from Zh. Fiz. Khim.; 48: No. 6, 1536-1538(Jun 1974).

The thermodynamic functions for the equilibrium involving the oxides $ZrO_{0.46}$ and ZrO_{2-y} were determined by an emf method using a solid electrolyte based on ThO_2 with cathodic reduction of the electrode surface. The thermodynamic functions for the formation of the oxide $ZrO_{0.46}$ from the elements were calculated: $\Delta H^{\circ}_{f,298} = -64.1 \pm 6.1$ kcal mole^{-1}, $\Delta S^{\circ}_{f,298} = -6.9 \pm 3.5$ eu, and $S^{\circ}_{298} = 13.7 \pm 3.6$ eu. (auth)

30130 CRYSTAL DISTORTION RESULTING FROM LONG-RANGE ORDER IN VANADIUM CARBIDE. Lewis, M. H. (Aarhus Univ., Denmark). Phil. Mag.; 31: No. 1, 173-178(Jan 1975).

A guinier x-ray camera was used to determine the cubic sublattice distortion which accompanies carbon atom/vacancy ordering in vanadium carbide crystals of composition between $VC_{0.75}$ and $VC_{0.84}$. The metal atom sublattice is reduced to rhombohedral symmetry with unit-cell angle 90.12 ± 0.03°. The internally twinned, lenticular plate-like morphology and specific habit plane observed in partially transformed crystals may be explained by the reduction in strain energy associated with interfaces between the long-range ordered phase and the cubic matrix. (auth)

30131 PROCESS FOR THE PREPARATION OF METAL CARBIDE AND METAL OXIDE MICROSPHERES. Block, J.; Herbst, R. J.; Triggiani, L. V. (to W. P. Grace and Co.). US Patent 3,865,745. 11 Feb 1975. Filed Date 1 Sep 1972. 8p.

A process was developed for preparing metal carbide microspheres and metal carbide microspheres containing excess carbon from ion exchange resins. The carbon-to-metal ratio in the product is controlled by heating in the presence of steam or other oxidizing gas after first heating the metal exchanged resin beads in an atmosphere of hydrogen and steam to remove sulfur. (auth)

30132 METAL-BONDED CUBIC BORON NITRIDE CRYSTAL BODY. Fontanella, E. L. (go General Electric Co.). US Patent 3,868,234. 25 Feb 1975. Filed Date 1 Nov 1972. 6p.

Cubic boron nitride crystals were bonded together into an abrasive body with an alloy bonding medium. The preparation of this abrasive body includes selection of an alloy (using separate metals to be alloyed in situ or pre-formed alloy) to be used comprising a first metal selected from the group consisting of aluminum, silicon, cobalt, nickel, chromium, molybdenum, tungsten, vanadium, niobium, tantalum, titanium, zirconium, lanthanum and other rare earth metals with any metal that, when molten, will wet said first metal and form an alloy therewith that is homogeneous on solidification, said alloy having a melting point below about 1500°C. (auth)

30133 RAMAN-ACTIVE PHONONS IN α-BORON. Richter, W. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart); Ploog, K. Phys. Status Solidi (b); 68: No. 1, 201-205(1 Mar 1975).

Single crystals of the α-rhombohedral boron modification, prepared by chemical vapor deposition, were investigated by Raman scattering. Twelve quite strong peaks were observed in the Raman spectrum. The results are compared with group theoretical predictions and a lattice dynamical model, recently developed for α-boron. (auth)

30134 PARAMAGNETIC CENTERS IN AMORPHOUS BORON. Koulmann, J. J.; Gewinner, G.; Kubler, L.; Jaegle, A. (Centre Universitaire du Haut-Rhin, Mulhouse, France). Phys. Status Solidi (b); 68: No. 1, K45-K45.

Results of ESR measurements on powdered samples of amorphous boron over a temperature range from 77 to 800°K are reported. At room temperature, a symmetrical ESR line was observed, and the lineshape was found to be nearly Lorentzian. The g-factor, determined by comparison with the known value of DPPH, remained unchanged through the experiment and was found to be 2.0028 ± 0.0002, which is very close to the free electron value and suggests a nearly complete quenching of the orbital momentum. (PMA)

30135 EFFECTS OF FAST NEUTRON IRRADIATION INDUCED DEFECTS ON THE SHIFT OF FERROELECTRIC TRANSITION TEMPERATURE. Demyanov, V. V.; Shedrin, M. I. (Inst. of Physical Chemistry, Moscow). Ferroelectrics; 8: No. 3-4, 607-610(1974).

Experimental and theoretical studies of the dielectric anomalies in irradiated perovskite-type ferroelectrics were completed. The three principal regions in the dependence of the transition temperature on the fast neutron integral flux were revealed. The observed data are discussed in terms of soft-mode concept and the radius of correlation restriction caused by radiation defects. The peak of dielectric susceptibility is shown not to coincide with the transition temperature, so a determination of the transition temperature from dielectric measurements should be made with caution. (auth)

30136 INVESTIGATION OF THE [1,0,0] POLARIZATION OF IRON-DOPED BARIUM TITANATE UNDER IRRADIATION. I. Experimental. Chanussot, G.; Thiebaud, C. (Laboratoire de Dielectriques, Dijon, France). Ferroelectrics; 8: No. 3-4, 665-670(1974).

An investigation of the pyroelectric effect was performed on iron-doped barium titanate (and also on cobalt-doped barium titanate) in the [1,0,0] direction, during both continuous and limited irradiation. The results obtained reveal an alteration of both the ferroelectric and paraelectric properties, characterized especially by a polydomainization (appearance of a diffuse phase transition ($T < T_c$)) and by an unusual electrical discharge ($T > T_c$). The results indicate that a new coupling between anharmonic properties and electrons must be introduced, during and after a photoelectric active irradiation. (auth)

30137 STATIC PSEUDO JAHN–TELLER EFFECT AT POINT DEFECTS IN IRRADIATED FERROELECTRIC CRYSTALS (PEROVSKITE STRUCTURES). II. Theoretical. Chanussot, G. (Laboratoire de Dielectriques, Dijon, France). Ferroelectrics; 8: No. 3-4, 671-683(1974).

The pyroelectric current spectrum (P. C. S.) measured in iron-doped barium titanate shows new features which can be explained taking into account a static pseudo Jahn–Teller effect both at trapped-electron defect centers (T. E. D. C.) and at photoexcited electron defect centers (P. E. D. C.). Furthermore it is necessary to introduce a polaronic exchange between T. E.D. C. and P. E. D. C. (The role of the dynamic part of the Jahn–Teller effect does not have to be considered although it is not necessarily weak). The static part of this effect is introduced by the interaction of a single phonon mode and a two-electronic level system. The contribution of this effect is found greater at T. E. D. C. than at P. E. D. C. The model differs from the latest ones proposed for barium titanate (Fridkin) and for lithium niobate (Staebler) so far as they do not include the Jahn–Teller effect but rather macroscopic internal fields. Our model does not exclude this last possibility. (auth)

30138 NEUTRON PARAMAGNETIC SCATTERING OF MANGANESE OXIDE AND MANGANESE ALLOY. Watanabe, N. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science); Ishikawa, Y.; Tsuzuki, K.; Kohgi, M.; Noda, Y. Kakuriken Kenkyu Hokoku; 6: No. 2, 284-292(Dec 1973). (In Japanese).

A focused monochrometer was used to investigate the direct interaction between magnetic ions. Neutron paramagnetic scattering was performed on MnO, $MnGeO_3$ (pyroxene), $MnGeO_3$ (ilmenite) and so on. The monochrometer was installed on an electron linear accelerator. Results of the paramagnetic scattering on MnO was compared with the results of spin wave. Semi-logarithmic plot of scattered neutron intensity in relation to the square of energy transfer was obtained. The value of $\hbar^2\langle\omega^2\rangle$ was 77.1(MeV)^2 after the correction of resolution. This value was in agreement with the value 70.4(MeV)^2 ($J_1 = -0.383$ MeV, $J_2 = -0.458$ MeV) by Kohgi et al. and the value 74.8(MeV)^2 ($J_1 = -0.416$ MeV, $J_2 = -0.434$ MeV) by collins. The value of $\hbar^2\langle\omega^2\rangle$ of $MnGeO_3$ (pyroxene) was 4.78(MeV)^2 ($J_1 = -0.207$ MeV, $J_2 = -0.098$ MeV). The measured value of $\hbar^2\langle\omega^2\rangle$ of $MnGeO_3$ (ilmenite) was 51.5(MeV)^2. The paramagnetic scattering of a single crystal was investigated by using the single crystal of Heusler type alloy Pd_2 Mn Sn. The results of the present experiment showed that the measurement of paramagnetic scattering can be done with a single crystal of 2 ~ 3 cm^3 by using the present apparatus. The quasi elastic scattering due to the paramagnetic scattering shows a typical gaussian type spectrum around zone boundary. The obtained scattering amplitude was in good agreement with the value determined from JI of spin wave experiment. (JA)

30139 METAL–NON METAL TRANSITION IN VO_2: X-RAY PHOTOEMISSION AND RESISTIVITY EXPERIMENTS. Blaauw, C. (Rijksuniversiteit, Groningen, Netherlands). pp 101-119 of Investigation of Some Systems Exhibiting Electrical Conduction Anomalies. Blaauw, C. (ed.). Groningen, Netherlands; Rijksuniversiteit (1974).

The temperature dependence of the band gap in semiconducting VO_2 was determined by means of XPS measurements. The results are in good agreement with the results obtained in resistivity

measurements. The energy gap is found to be temperature dependent with a room temperature value of 0.3 eV. The vanadium 3d bandwidth increases above the transition temperature. The core lines, which are asymmetric below T_t, broaden and become symmetric above T_t. These changes in line shape and line width are due to the difference in the response of the valence electrons in the metal to a sudden pertubation as made in an XPS experiment. They are discussed in terms of the theory of Doniach and Sunjic. A new model is discussed to explain the symmetrical broadening in the metallic region, which requires that the core hole- valence electron interaction is comparable to the bandwidth. The relative shift in the O-1s and V-2p peak positions below and above T_t indicates a transfer of charge from the V^{4+} to the O^{2-} ion in the semiconducting region, suggesting a more covalent bond than in the metallic phase. (NL)

30140 METAL–NON METAL TRANSITION IN VO_2: A ^{57}Fe MOESSBAUER STUDY. Blaauw, C. (Rijksuniversiteit, Groningen, Netherlands). pp 66-100 of Investigation of Some Systems Exhibiting Electrical Conduction Anomalies. Blaauw, C. (ed.). Groningen, Netherlands; Rijksuniversiteit (1974).

The system $V_{1-x}Fe_xO_2$ was investigated in the region $O \leq x \leq 0.04$ with the Moessbauer effect technique. Both stoichiometric and non-stoichiometric material was studied. The results indicate that trivalent iron is present in all cases. The different crystallographic phases in the system were distinguished through their Moessbauer spectra. The spectra obtained in M1 phase material, which has a small impurity concentration, suggest the presence of impurity induced structural distortions, depending on the history of the samples. In oxygen deficient samples shear planes are formed in which Fe^{3+} ions preferentially occupy the cation positions. (NL)

Metals and Alloys

Refer also to abstracts 29140, 29778, and 30093.

30141 (AD-784962) LONG RANGE MATERIALS RESEARCH. Annual Technical Report, 1 July 1973–30 June 1974. Huggins, R. A. (Stanford Univ., Calif. (USA)). 30 Jun 1974. 178p. (CMR-74-6). NTIS $5.50.

Contents include generation of coherent vacuum ultraviolet and soft x-ray radiation; detection of x-radiation; superplasticity and warm working of plain high carbon steels; superplasticity of Pb–Sn and Pb–Sn–Au alloys; synthesis of new types of catalyst materials; and development of elevated temperatures electrocrystallization techniques. (GRA)

30142 (AGC-2014(Vol. 4)) BENDIX NERVA PROGRAM. Final Report, Phase I. Volume IV. Development Test Program (Topical Reports). (Bendix Corp., Southfield, Mich. (USA). Research Labs. Div.). 10 Jan 1962. 167p. Dep. NTIS $11.50.

Results of research on Nerva engine components are presented. Data and information are included on materials for bearings, gears, and lubricants. Design information is also included on permanent-magnet torque motors and magnetic servo amplifiers. Results of NERVA transmission tests are summarized. (JRD)

30143 (RDT-M-6-1T(2-75)) ALLOY STEEL BOLTING MATERIAL FOR LOW-TEMPERATURE SERVICE (ASME SA-320 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Feb 1975. 9p. RSO.

This standard covers alloy steel bolting material for low-temperature service in nuclear and associated applications. Included are general requirements, basis of purchase, additional requirements, application supplements, and optional provisions. (DLC)

30144 (RDT-M-6-5T(2-75)) ALLOY STEEL BOLTING MATERIAL FOR SPECIAL APPLICATIONS (ASME SA-540 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Feb 1975. 8p. RSO.

The special applications are in nuclear and associated service environments. (DLC)

30145 (TID/SNA-626) NERVA MATERIALS PROGRAM PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 35p. Dep. NTIS $4.75.

Quality control programs for Nerva reactor materials are described. Information is included on materials management, material services, materials data generation, drawing checkoff plans, and properties traceability plans. (JRD)

30146 (TID/SNA-828) QUARTERLY PROGRESS REPORT, FIRST QUARTER CY 71. Project 187. Materials and Processing Development Activities, First Quarter 1971. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 156p. Dep. NTIS $11.00.

Materials and processes development activities for the first quarter of Contract Year 1971 are reported. Materials development topics include: (1) materials properties data book list to classify ductile and brittle behavior of materials; (2) property-data development reports that include toughness properties of aluminum alloy (AA) 7039-T63, tensile properties of seven candidate alloys, the thermophysical properties of AISI 347, AA 7039-T63, and Ti-5Al-2.5Sn ELI; (3) radiation damage effects from GTR-20C tests; (4) gaseous-hydrogen embrittlement of Ti-5Al-2.5Sn ELI; (5) improved statistical approach to developing design allowables for AA 7039 fracture toughness and fatigue; (6) planning of material test activities for CY 71 and beyond; and (7) simulated weld specimen of primary-injector L-channel configuration utilizing the metal-inert-gas short arc weld process. Component support topics include: (1) effect of simulated braze cycle on ARMCO 22-13-5 nozzle candidate material; (2) stress corrosion susceptibility of AA 7039-T63 pressure-vessel candidate material; (3) program to establish Category-A cyclic stress intensity (K_I) for prime TPA rotor material Ti-5Al-2.5Sn ELI; (4) impact tensile testing of Ti-5Al-2.5Sn ELI for valve and actuator applications; (5) filler-less orbital welding of AA 6061-T6 and AISI 347 tubing for line-use evaluation; (6) fabrication of three-dimensional woven-fiber graphite nozzle extension; (7) creep and tensile testing of arc-cast and pressed-and-sintered tungsten alloyed with 25% rhenium in hydrogen at 3800 and 4000°F. (auth)

Corrosion and Erosion

Refer also to abstracts 31312 and 31827.

30147 (AD-785020) OBSERVATIONS ON THE STRESS CORROSION CRACKING OF AN Al–5% Zn–2.5% Mg TERNARY AND VARIOUS QUARTERNARY ALLOYS. Green, J. A. S.; Montague, W. G. (Martin Marietta Labs., Baltimore, Md. (USA)). Aug 1974. Contract N00014-74-C-0277. 29p. (MML-TR-74-23C). NTIS $3.25.

Studies were undertaken to test a concept of controlling stress-corrosion crack propagation in Al–Zn–Mg alloys through the use of minor alloying additions of elements known to retard hydrogen ion recombination such as Cd, As, Zr, and Cr. Results indicated that the concept was invalid since the minor alloying additions themselves exerted a more profound influence on the grain boundary microstructure. Specifically, the microstructural features of grain boundary particle size and interparticle spacing were found to correlate with stress corrosion susceptibility. Auger electron spectroscope studies also revealed a correlation between the concentration of Zn and Mg within the precipitate-free zone and the susceptibility to cracking. (GRA)

30148 (AED-CONF-74-538-002) EXAMINATION OF WELDMENTS OF A SODIUM LOOP OF STAINLESS STEEL NO. 4571 AFTER OPERATION. Borgstedt, H. U.; Frees, G.; Drechsler, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). 1974. 6p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

7 figs.; 2 tabs.; 11 refs. Available from ZAED.

Results of x-ray examinations of stainless steel × 10 CrNiMoTi 18 10 TIG weldments with filler after 28,000 hours of operation with dynamic sodium at 380 to 600°C are presented. No specific Na-corrosion effects at the weldments were found. (auth)

30149 (AED-CONF-74-538-015) STEAM GENERATOR FAILURE AT THE KNK-REACTOR PLANT. Lorenz, H.; Herberg, G. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). 1974. 5p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F.R. Germany (23 Oct 1974).

5 figs.; 2 tabs. Available from ZAED.

Following a description of the plant and its operation situation in the event of failure, the course of the disturbance, localization and investigation of the failure, as well as the investigation of further welded joints, are described in detail. The fabrication and testing of the steam generator are explained and indications to clarify the cause of the failure are given. (auth)

30150 (AED-CONF-74-538-031) THE INFLUENCE OF SULPHIDES ON HOT CRACKING AND NOTCH TOUGHNESS IN HEAT-AFFECTED ZONE DURING WELDING OF HIGH-YIELD STEELS. Wellnitz, G.; Schmidtmann, E. (Technische Hochschule Aachen (F. R. Germany). Inst. fuer Eisenhuettenkunde). 1974. 7p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

12 figs.; 14 refs. Available from ZAED.

Formation of hot cracks in steel HAZ are analyzed. Hot cracking susceptibility of steel by a hot ductility test is described. An ex-

planation of crack susceptibility-factor for estimating the examined steels is given. Results of an investigation of notch toughness of specimens treated under simulated welding conditions are included. (auth)

30151 (COO-2462-1) PITTING AND STRESS CORROSION CRACKING BEHAVIOR OF AUSTENITIC STAINLESS STEEL WELDMENTS CONTAINING RETAINED FERRITE. Progress Report, June 1, 1974–May 31, 1975. Duquette, D. J.; Savage, W. F. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Dept. of Materials Engineering). 1975. Contract AT(11-1)-2462. 7p. Dep. NTIS $4.00.

Pitting experiments on duplex stainless steel weld metal (≈ 8% ferrite) in 1N NaCl showed pit initiation resistance to be improved over that of unwelded austenitic steel. Pit growth, on the other hand, has been shown to be seriously accelerated in the duplex materials. Repassivation of propagating pits occurred at only slightly more noble potentials in the welded material. Pit initiation in the duplex materials was associated with the austenite/ferrite interface, and growth was shown to occur as subsurface cavities rather than the hemispherical type of pitting associated with single phase austenite. Observed behavior appears to be associated with micro-segregation during solidification. Slow-strain-rate stress-corrosion cracking tests of single phase and duplex (welded) stainless steels were conducted in boiling 35 to 42% NaCl. In the single-phase material, intergranular crack initiation was observed at bp < 135°C and transgranular cracking observed at bp = 154°C. In all-weld-metal samples, cracking was confined to the austenite/ferrite interface at all temperatures. A large decrease in ductility was observed for both types of materials exposed to the boiling chloride solutions. In specimens with a single transverse weld, it was observed that below 135°C, cracking occurred in the weld metal but that at 154°C, cracking was confined to the base alloy. As in the case of pitting, this behavior appears to be associated with the character of the austenite/ferrite interphase region. (auth)

30152 (GEAP-12536) STRESS CORROSION STUDIES OF LMFBR STEAM GENERATOR MATERIALS. Indig, M. E. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Aug 1974. Contract AT(04-3)-893. 18p. AT.

A program of caustic cracking of various ferritic and austenitic alloys was initiated in order to determine the best construction material for the LMFBR steam generator. The testing environment simulated faulted conditions in the evaporator and the superheated steam sections of the steam generator. Many of the austenitic alloys were found to be susceptible to caustic cracking. At 600°F (evaporator temperature), cracking was found in samples of Carpenter 20 Cb 3, Armco 22-13-5, Type 304 stainless steel, and Incoloy-800 in 3% caustic. Inconel-600 failed when stressed below yield in caustic contaminated steam at 900°F (superheater temperature). The 2¼ Cr–1 Mo steel was found extremely resistant to caustic cracking and has been chosen as the construction material for the steam generator. (19 figures) (auth)

30153 (GEAP-14029-1) STEAM GENERATOR MATERIALS ENGINEERING FIRST QUARTERLY REPORT, JULY–SEPTEMBER 1974. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1974. Contract AT(04-3)-893. 24p. AT.

The objective is to characterize 2¼ Cr–1 Mo and stainless steels for compatibility with expected LMFBR steam generator environments. Preliminary characterization of the base metal and all-weld-metal tubes (2¼ Cr–1 Mo) was completed for the interrupted creep and decarburization studies. Testing showed that 2¼ Cr–1 Mo welds are as resistant to stress corrosion as the base metal, and that this steel is highly resistant to stress corrosion cracking. Construction of the IHTS simulation (Loop B) and modification of Loop 1R are reported. (DLC)

30154 HALOGEN STRESS CORROSION CRACKING OF ZIRCALOY-4 TUBING. Busby, C. C.; Tucker, R. P.; McCauley, J. E. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). J. Nucl. Mater.; 55: No. 1, 64-82(Jan 1975).

The stress corrosion behavior in the presence of iodine vapor or chlorine gas of unirradiated, recrystallized and stress-relieved Zircaloy-4 as a function of hoop stress, test temperature and contaminant concentration was investigated using internally pressurized tube specimens. Comparison with similarly tested control specimens (no halogen) shows that at 360°C and 400°C as little as 0.005 to 0.01 mg halogen per cm^2 Zircaloy surface is sufficient to reduce failure time for hoop stresses above 21 to 24 kpsi. Failure time appears to be essentially independent of iodine up to 0.08 mg/cm^2. At equivalent stress ratios ($\sigma_{applied}/\sigma_{YS}$) with iodine the higher temperature results in shorter failure times over most of the stress range investigated, and stress-relieved material generally failed before recrystallized material. Failures were typically pinholes except at high stresses where stress rupture occurred. Scanning electron microscopy revealed intergranular failure in recrystallized specimens and the presence of fluted facets in both materials. (auth)

30155 PREDICTION OF CORROSION PRODUCT STABILITY IN HIGH-TEMPERATURE AQUEOUS SYSTEMS. Rummery, T. E.; MacDonald, D. D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). J. Nucl. Mater.; 55: No. 1, 23-32(Jan 1975).

Calculated thermodynamic data for metal oxidation/oxide reduction reactions of Fe, Ni, Co and Cu, and for formation, oxidation and reduction of $NiFe_2O_4$, $CoFe_2O_4$, $CuFeO_2$ and $CuFe_2O_4$, were examined for aqueous systems containing dissolved hydrogen and oxygen at temperatures up to 300°C. The data are presented as equilibrium partial pressures of oxygen and hydrogen for specific reactions. This information is used to predict which solids are stable in an equilibrium system containing known concentrations of oxygen and hydrogen, and in a non-equilibrium system in which γ and neutron radiation fields cause the concentrations of oxygen and hydrogen to be much greater than the equilibrium values. Results of X-ray diffraction studies of corrosion products filtered from the heat-transport system of the Douglas Point Generating Station are compared with phase stability predictions. (auth)

30156 MECHANICAL STUDY OF STRESS CORROSION OF U-10 WT % Mo ALLOY. Nomine, A. M.; Bedere, D.; Robin, R.; Miannay, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). Mem. Sci. Rev. Met.; 71: No. 7, 475-489 (Jul 1974). (In French).

From autumn meeting on metallurgy; Paris, France (27 Sep 1971).

The corrosion resistance under stress of a U–Mo alloy containing 10% molybdenum by weight was studied in the laboratory atmosphere and in water at room temperature. The two states investigated, rough-cast and homogenized metastable BCC structure, have similar mechanical properties. The resistance in these media is found to be the same. Propagation takes place after an incubation time and its rate is constant. The slow cracking is ramified and transgranular in air, nonramified and mixed in water. The final rupture is intergranular. The rupture surfaces examined after the rupture are described. (FR)

30157 OXIDATION OF ALLOYS AT HIGH TEMPERATURE. Kofstad, P. (Sentralinstitutt for Industriell Forskning, Oslo (Norway)). Sci. Tech. (Paris); No. 16, 35-47(15 Sep 1974). (In French).

The dense and compact oxide layers are first considered. The oxidation rate in these layers is governed by solid state diffusion phenomena. The Wagner parabolic oxidation theory is recalled and the diffusion in alloy oxides is especially examined (formation of dense and compact oxide layers at the beginning of the oxidation and thick and porous layers at high temperature). The oxidation of Co–Cr and Ni–Cr binary alloys is studied together with the effect of Al additions in Ni–Cr, Co–Cr and Fe–Cr based alloys. The adhesion and separation of the oxide layers are discussed. (FR)

30158 CORROSION IN AQUEOUS SOLUTIONS AND CORROSION IN HIGH TEMPERATURE GASES: RESEMBLANCE AND DIFFERENCE. Wagner, C. (Max-Planck-Institut fuer Biophysikalische Chemie (Karl-Friedrich-Bonhoefer-Inst.), Goettingen (F. R. Germany)). Sci. Tech. (Paris); No. 16, 10-17(15 Sep 1974). (In French).

The corrosion of pure metals is discussed and the importance of the electrochemical phenomena is established from the results obtained in both types of corrosion. The corrosion of alloys is also presented. In spite of the differences between dry and humid corrosion, the resemblances between them are strong enough so that the results of one can be applied to the study of the other. (FR)

30159 5TH EUROPEAN CORROSION CONGRESS. Chateau, M. Sci. Tech. (Paris); No. 16, 65-76(15 Sep 1974). (In French).

The communications presented at the 5th European corrosion congress are analyzed. The subjects dealt with are as follows: behavior of materials in corrosive media in particular industrial plants (nuclear, seawater desalination, chemical industry, engineering, building, maritime and aeronautic constructions); general studies of materials in contact with corrosive media (uncoated materials, composite materials and coatings); study of surface layers formed by corrosion; corrosion media (atmospheric sulphurous, CO_2, marine and halogenated media); influence of physical and mechanical factors on corrosion phenomena (surface states, corrosion under stress, simultaneous abrasion and corrosion, embrittlement by hydrogen); special forms of corrosion (intergranular, pitting, cavity, formation); research and testing methods. (FR)

30160 EXAMINATION OF THE MECHANISMS INVOLVED IN THE OXIDATION OF THE ALIGNED EUTECTIC ALLOY Ni_3Al–

Ni_3Nb. Smeggil, J. G. (General Electric Corp., New York). Oxidation Metals; 9: No. 1, 31-44(Feb 1975).

The aligned eutectic alloy Ni_3Al-Ni_3Nb at 1155°C exhibits an initial very rapid rate of oxidation which eventually decreases to a very significantly lower level. This decrease in the rate of oxidation was shown to be associated with the formation of an aluminum oxide layer. Work was conducted to determine both how such a layer forms in oxidation at 1155°C as a function of time and which elements are the active diffusing species in the oxidation process. (auth)

30161 OXIDATION AND HOT CORROSION BEHAVIOR OF TUNGSTEN-FIBER REINFORCED COMPOSITES. El-Dahshan, M. E.; Whittle, D. P.; Stringer, J. (Univ. of Liverpool). Oxidation Metals; 9: No. 1, 45-67(Feb 1975).

The oxidation and hot corrosion behavior of a tungsten-fiber, reinforced Ni-20Cr alloy was examined under the following exposure conditions: (1) pure oxygen at 1 atm pressure; (2) sulfidation in $H_2-10\%$ H_2S; (3) presulfidation in $H_2-10\%$ H_2S followed by oxidation in oxygen; and (4) oxidation in 1 atm oxygen after precoating with approximately 1 mg/cm^2 of Na_2SO_4. Rapid oxidation of the tungsten fibers causes considerable distortion of the matrix and catastrophic degradation of the matrix follows. Interdiffusion between the matrix and the fibers is also important. During sulfidation, only the matrix forms sulfides, the fibers remaining unaffected. Consequently, presulfidation, although having a dramatic effect on the oxidation of the matrix does not have a damaging effect on the fibres. Equally, the presence of sodium sulfate is not critical, although severe oxidation of the exposed tungsten fibers is still observed. (auth)

Preparation and Fabrication

Refer also to abstract 32247.

30162 (AD-785915) DEVELOPMENT AND TESTING OF CONTINUOUS QUENCHING AND CONSOLIDATION TECHNIQUES FOR THE BULK PRODUCTION OF METASTABLE ALLOYS. Final Report. Giessen, B. C. (Northeastern Univ., Boston, Mass. (USA). Solid State Chemistry Lab.). 6 Sep 1974. Contract N00014-68-A-0207-0006. 9p. (N-14-68-A-207-6-2). NTIS $3.25.

The design, construction and testing of a splat cooling unit based on a plasma gun are discussed, as well as studies on the production and processing of bulk quantities of amorphous Cu-Zr alloys prepared with this unit. (auth)

30163 (AEC-CONF-74-538-016) WELDING TECHNICAL TASKS IN THE MANUFACTURE OF VALVES FOR NUCLEAR POWER STATIONS. Kilian, H. J. 1974. 5p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

8 figs. With abstract in English. Published in DVS-Ber. (No. 32).

Design and materials of reactor-valves are discussed along with standardizing and performance of integral-joint and seal welding, post-heating, welding supervision, testing and documentation. (auth)

30164 (CONF-730566-P2) 4th SYMPOSIUM ON ELECTROPLATING, BUDAPEST, HUNGARY, 7-11 MAY 1973. II. Lectures. (Scientific Society of Mechanical Engineers, Budapest (Hungary)). 1973. 179p. (In German and English). Dep. NTIS (US Sales Only). $12.00.

Twenty-three contributions on the techniques and mechanisms of electrodeposition and on the properties of electrodeposited materials are compiled. Separate abstracts were prepared for two articles. (JSR)

For abstracts of individual papers see: 30165 and 30166.

30165 (CONF-730566-P2, pp 301-308) GLOSSY ZINC AND CADMIUM DEPOSITS FROM ACID ELECTROLYTES. Korpiun, J. 1973. (In German).

From 4th symposium on electroplating; Budapest, Hungary (7 May 1973).

In 4th symposium on electroplating.

Conditions for the deposition of glossy Zn or Cd deposits from acid electrolytes and the effects of modifying these conditions on the quality of the deposits are discussed. (JSR)

30166 (CONF-730566-P2, pp 385-392) EFFECT OF BATH CONSTITUTION AND INTERNAL STRESS ON THE GENERATION OF CRACKS IN THE ELECTRODEPOSITED Ni-Mo ALLOYS. Kinh, V. Q.; Chassaing, E. 1973.

From 4th symposium on electroplating; Budapest, Hungary (7 May 1973).

In 4th symposium on electroplating.

It has been shown that by means of proper composition of the sodium citrate bath and adequate cathode current density, crack-free Ni-Mo coatings can be electrodeposited. In the present study, the effect of current density on internal stress, chemical composition and critical thickness of the Ni-Mo deposits was investigated. The stress rises quickly with Mo content in the deposits. The sulfamate bath gives higher current efficiency and larger critical thicknesses than the chloride or sulfate baths. The dependence of crack generation on experimental conditions and on some intrinsic parameters of the deposits is discussed. (auth)

30167 (RDT-M-1-3T(3-75)) MILD STEEL COVERED WELDING ELECTRODES (ASME SFA-5.1 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Mar 1975. 5p. RSO.

The material has to conform to the requirements of ASME SFA-5.1, ASME boiler and pressure vessel code (Section III, Article NB-2000), and to the additional requirements of this standard. (DLC)

30168 (RDT-M-1-4T(3-75)) LOW ALLOY STEEL COVERED WELDING ELECTRODES (ASME SFA-5.5 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Mar 1975. 5p. RSO.

This standard is for nuclear and associated applications. (DLC)

30169 (RDT-M-3-33T(2-75)) 2-1/4-PERCENT-CHROMIUM, 1-PERCENT-MOLYBDENUM ALLOY STEEL SEAMLESS TUBES (ASME SA-213 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Feb 1975. 9p. RSO.

The tubes are to be used in heat exchangers and steam generators for nuclear and associated applications. The material shall conform to the requirements of ASME SA-213, Grade T22; ASME boiler and pressure vessel code (Sect. III, Article NB-2000); and to the additional requirements of this standard. (DLC)

30170 (RDT-M-6-3T(2-75)) ALLOY STEEL BOLTING MATERIAL FOR HIGH-TEMPERATURE SERVICE (ASME SA-193 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Feb 1975. 9p. RSO.

This standard covers bars, bolts, screws, studs, and stud bolts for nuclear and associated applications. (DLC)

30171 (RN-S-0516) PREVENTION OF RUST IN THE ID WELD AND HEAT AFFECTED ZONE OF CRES 347 NERVA LINES. Fletcher, C. W. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Aug 1969. 26p. Dep. NTIS $4.50.

NERVA stainless-steel lines that transport fluids must satisfy rigid levels of cleanliness. One of the most persistent causes of contamination has been the formation of rust in the welds and heat-affected zones of the lines. A three-phase program was conducted to devise preweld methods of preventing postweld rust on the interior surfaces of weld joints. Results indicated that proper preweld treatment, with optimum backup shielding, will prevent postweld rust in the line interior weld and heat-affected zone. (auth)

30172 (SAND-74-8019) TECHNIQUES FOR QUANTITATIVELY MEASURING ADHESION OF ELECTRODEPOSITS. Dini, J. W.; Johnson, H. R. (Sandia Labs., Livermore, Calif. (USA)). Nov 1974. Contract AT(29-1)-789. 37p. (CONF-750412-2). Dep. NTIS $5.00.

From spring meeting of SAMPE; San Diego, California, USA (15 Apr 1975).

Five techniques for quantitatively testing the adhesion of electrodeposits are reviewed: ring shear, conical-head tensile, modified Olard, I-beam, and flyer plate. All have been shown to be quite effective in providing consistently reproducible data. Details are presented for each test including shape and size of specimens, preparation of specimens, and manner in which the test is performed. Cost comparisons and facility requirements are also defined, and data for various substrate-electrodeposit combinations are included. (8 tables, 17 fig) (auth)

30173 (TID/SNA-1366) RESULTS OF A DEVELOPMENT PROGRAM CONDUCTED BY THE MARQUARDT CORPORATION TO ESTABLISH TECHNIQUES AND TOOLING FOR PRODUCTION OF A REGENERATIVELY-COOLED ROCKET NOZZLE FOR AEROJET-GENERAL CORPORATION. Interim Report 15085. Creer, R. Y. (Marquardt Corp., Ogden, Utah (USA)). 18 Nov 1963. 48p. Dep. NTIS $5.50.

Progress in the program for establishing suitable processes for the manufacture, assembly, and fabrication of the regeneratively cooled nozzle for the NERVA rocket during the period from April to mid-November 1963 is reported. (LCL)

30174 ELECTRON BEAM WELDING STUDY OF U-0.2 WT % V ALLOY. Prunier, C.; Linard, M. (CEA Centre d'Etudes de

Valduc, 21-Is-sur-Tille (France)); Guillaumin, J.; Giraud-Heraud, F. (Societe Industrielle de Combustible Nucleaire (SICN), Laboratoires de Veurey, 38 (France)). Mem. Sci. Rev. Met.; 71: No. 7, 461-473(Jul 1974). (In French).

The typical structures identified in zones affected during electron beam welding were developed in U-0.2 wt % V alloy test samples by simulation of the welding cycles. Their formation kinetics were determined and their mechanical properties characterized. (FR)

30175 METAL OR METALLOID COATINGS IN THE PURE STATE. Dejachy, G.; Gillardeau, J. (to CEA, 75-Paris (France)). French Patent 2,205,583/A/. 7 Nov 1972. 12p. (In French).

A method for obtaining metal (or metalloid) coatings in the pure state from corresponding higher valence fluorides is described. The method consists in introducing, in the vapor state, at least one higher-valence metal (or metalloid) fluoride into an enclosure containing at least one substrate to be metal coated and a source for generating the metal (or metalloid) to be deposited, heating said source so that the higher valence fluoride is transformed, in contact with the source, into a subfluoride which is evaporated, condensed on the substrate and transformed into fluorine and into the metal (or metalloid) forming the desired deposit. The invention can be applied in particular to electronics, for the manufacture of tungsten electric converter emitters. (FR)

30176 THERMAL REDUCTION OF SAMARIUM, EUROPIUM AND YTTERBIUM OXIDES BY ALUMINIUM. De Godoy, J. M.; Grjotheim, K.; Herstad, O.; Krohn, C. (Trondheim Univ. (Norway). Norges Tekniske Hoegskole). Rev. Chim. Miner.; 11: No. 5, 533-546(1974).

The reaction mechanisms and the equilibrium vapor pressures were investigated. Vapor pressure measurements were made by the Knudsen effusion technique over a pressure range from $10^{-3.5}$ to 10^{-5} atm. By the thermal reduction of Sm_2O_3 the following equilibrium system was established: $Sm_2O_3-Sm_2O_3 \cdot Al_2O_3-Al-Sm$ with Al present as an alloy containing up to 41 to 42 at. % Sm. In the system Eu_2O_3-Al, a three-step reaction was found: the first step ($Eu_2O_3 + Al$) $EuO + 3EuO \cdot Al_2O_3$), showing that Eu_2O_3 is unstable in the presence of Al, and the second and third steps represented by the respective equilibria: $EuO-3\ EuO \cdot Al_2O_3-Al-Eu$ and $3\ EuO \cdot Al_2O_3-EuO \cdot Al_2O_3-Al-Eu$. The equilibrium phases of Al contain approx. 4 at. % Eu. The equilibrium system established by the aluminothermal reduction of Yb_2O_3 is $Yb_2O_3-3\ Yb_2O_3 \cdot 5\ Al_2O_3-Al-Yb$ with Al present as a solid or liquid Al-Yb alloy. The equilibrium pressures of rare earth metals in each system are given as temperature dependent equations obtained by linear least-squares fits of experimental points. The Gibbs free energy of formation of rare earth aluminates are evaluated. (FR)

30177 ISOSTATIC COMPACTION OF TUNGSTEN POWDER. Schob, O.; Geijtenbeek, J. J. F. (Philips Gloeilampenfabrieken N.V., Eindhoven, Netherlands). High Temp.-High Pressures; 6: No. 3, 261-275(1974). (In German).

From 8th Plansee seminar; Reutte, Austria (27 May 1974).

A simple apparatus and a procedure for the isostatic compaction of metal powders are briefly described. Some typical results of compaction tests with tungsten powder of 0.004 mm grain size at pressures up to 1500 N mm^{-2} are reported. For comparison, compaction characteristics of other metal powders with different powder properties are discussed with the object of developing a basic model for the compacting of metal powders. Theoretical expressions describing the dependence of density on pressure which would have general validity are too complex for practical applications; therefore preference was given to the derivation of an empirical pressure-density relation. Pressure-density results reported in the literature were analyzed in the light of data obtained in this work and an equation was derived which gives the dependence of density on pressure over a wider pressure range than heretofore reported. (auth)

30178 ELECTROLYTIC AMALGAMATION OF URANIUM USING AN ION EXCHANGE MEMBRANE. Lee, H. C.; Wang, L. C.; Hung, H. H.; Chang, C. T. (National Taing Hua Univ., Hsinchu, Taiwan). J. Chem. Soc., Chem. Commun.; No. 4, 124(19 Feb 1975).

A novel method for the preparation of uranium amalgam using an ion exchange membrane for adjusting pH during electrolysis is described. (auth)

30179 DIFFUSION WELDING OF COMMERCIAL BRONZE TO A TITANIUM ALLOY. Zanner, F. J.; Fisher, R. W. (Sandia Labs., Albuquerque, NM). Weld. J. (N. Y.); 54: No. 4, 105s-112s (Apr 1975).

From 55th AWS annual meeting; Houston, TX (6 May 1974).

An investigation was conducted to develop the techniques required to diffusion weld commercial bronze (Cu-10% Zn) to a titanium alloy (Ti-6Al-6V-2Sn) at 900°F. Results showed that surface condition is the most important parameter and that applied compressive stress did not influence bond shear strength. Fracture surfaces of coupons failed in shear were analyzed with a scanning electron microscope. Under optimal welding conditions, failure occurred in the commercial bronze matrix adjacent to the bond, and joint shear strengths of up to 29,000 psi were achieved. (PMA)

30180 METHODS FOR FABRICATING AND PLUGGING OF TUBE TO TUBESHEET JOINTS BY EXPLOSION WELDING. Hardwick, R. (Yorkshire Imperial Metals Ltd., Leeds, England). Weld. J. (N. Y.); 54: No. 4, 238-244(Apr 1975).

The weld characteristics, welding geometries, and process parameters for explosion welding are discussed. The principal advantages of this method are outlined: (1) lack of material compatibility problems; (2) superior joint integrity; (3) tolerance of wide dimensional variations; and (4) bonds can be ultrasonically assessed. (PMA)

Properties, Structure, and Phase Studies

Refer also to abstracts 29503, 29761, 30138, 30837, 31298, 31299, 31444, 31565, and 31816.

30181 (AD-785409) EFFECTS OF MICROSTRUCTURAL MODIFICATION ON TITANIUM TOUGHNESS AND FATIGUE. Kennedy, J. (Grumman Aircraft Engineering Corp., Bethpage, N. Y. (USA). Research Dept.). Aug 1974. 13p. (RM-590). NTIS $3.00.

Some effects of microstructure and chemical composition on the toughness and fatigue characteristics of titanium alloys after various heat treatments are described. The present studies were conducted on Ti-6 Al-4 V and Ti-6 Al-6 V-2 Sn plate and forging in the mill annealed and recrystallized annealed conditions. It was generally observed that fracture toughness (K_{Ic}) was improved by recrystallization annealing heat treatments and that lower alpha stabilizing contents (i.e., Al, O, N, and C) and grain coarsening were associated with higher K_{Ic} values. A similar trend for fatigue crack growth for these materials may have increased sensitivity to differences in microstructure and chemistry at low stress intensities during fatigue loading. (GRA)

30182 (AD-786787) DEFORMABILITY OF METALS AND BINARY ALLOYS. Tikhonov, A. S.; Osipov, V. G.; Bulat, S. I. 8 Apr 1974. Translation of Deformiroemost Metallov I Binarykh Splavov, Moscow, 1971. (FSTC-HT-23-683-74). 263p. NTIS $8.50.

The concept of deformability of metals, physicochemical and thermomechanical factors, stress state and other factors affecting deformability of metals and alloys are discussed. Methods of investigating resistance to deformation, plasticity and deformability are discussed. Plasticity and strength of metals of the iron, heavy nonferrous, light nonferrous, high melting, noble, alkali and alkali earth and heavy radioactive metals is discussed in detail. Deformability of several binary alloys with limited and unlimited solubility of components in the solid state is discussed, as well as superplasticity phenomena of two-phase alloys. (GRA)

30183 (AD-786805) ALUMINUM ALLOYS WITH HIGH CONTENT OF HIGH-MELTING METALS. Dobatkin, V. I.; Elagin, V. I.; Fedorov, F. M. May 1974. Translation of pp 163-169 from Metalloved. Tsvet. Splavov, Moscow, 1972. (FSTC-HT-23-0710-74) 14p. NTIS $3.25.

Up until recently it has been impossible to use more than small (<2%) amounts of high-melting metals in aluminum alloys. The use of high-melting components gives the alloy a number of valuable properties. Because coarse primary crystals of intermetallic compounds form in the alloys it is difficult to produce high-quality ingots. The article discusses new methods of producing such ingots—by increasing casting temperatures and decreasing the size of the ingots. Granulation of the melt and treatment of the granules under pressure is a radical new solution and the results of research in this field are presented. (GRA)

30184 (AD/A-000287) INVESTIGATION OF BASIC CREEP MECHANISMS OF TITANIUM ALLOYS. Final Report, 1 August 1973-1 August 1974. Paton, N. E.; Mahoney, M. W.; Williams, J. C. (Rockwell International Corp., Thousand Oaks, Calif. (USA). Science Center). 1 Aug 1974. Contract N00019-74-C-0052. 58p. NTIS $4.25.

Rate controlling creep mechanisms in Ti alloys were studied at 1000°F as a function of stress, alloy composition, and heat treatment. Alloying additions of Si, Bi, Ge, Fe, Mo, and Nb were added to a base alloy composition of Ti-5Zr-5Al and their effect on creep behavior established. Results of this model alloy study showed dislocation creep was the rate-controlling creep mechanism in all alloys, with precipitation on mobile dislocations becoming important in limiting dislocation mobility in the alloys containing Si. In addition, the model alloy study resulted in the

selection of two alloys that showed good creep resistance for further creep and mechanical properties evaluations. These were Ti–5Al–5Zr–0.5Si and Ti–5Al–5Zr–1Mo–0.5Si. Together with the two model alloys two Si-bearing commercial alloys, TI-11 and IMI-685, were also studied. (GRA)

30185 (AED-CONF-74-538-004) MECHANICAL PROPERTIES OF BUTT WELDS OF HEAVY WALL REACTOR COMPONENTS. Cerjak, H.; Papouschek, F.; Pellkofer, D. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). 1974. 29p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

Experience in submerged arc welding of up to 250 mm thick reactor components of low alloy steel 22NiMoCr37 (similar to A 508 cl. 2) are reviewed along with welding of low alloy NiMoCr and MnMo steels. Statistical data from tensile tests (room temperature and 350°C) and impact tests on weld deposits, and HAZ are included. (auth)

30186 (AED-CONF-74-538-006) STRUCTURAL SAFETY ANALYSIS OF REACTOR COMPONENTS IN MANUFACTURE, OPERATION AND IN-SERVICE INSPECTION. Bartholome, G.; Vasoukis, G. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). 1974. 6p. (In German). INIS.

From 2nd international colloquium: welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

10 figs.; 7 refs. With abstract. Available from ZAED.

Methods for detecting possible defects in welded reactor components are described. Methods for evaluation of defects due to manufacturing are also described along with safety analysis of reactor operation and safety assurance by in-service inspections. (auth)

30187 (AED-CONF-74-538-017) MORPHOLOGY OF THE TEXTURES AND THE MECHANICAL-TECHNOLOGICAL PROPERTIES OF THE BASE MATERIAL AND THE HEAT-AFFECTED ZONE. Mueck, G. H.; Grossmaas, H. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (F. R. Germany)). 1974. 26p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

7 figs.; 2 tabs.; 7 refs.

On simulated pieces (welding and stress relief heating) of steel 22 NiMoCr 37, the morphology textures and their mechanical-technological properties are demonstrated. (auth)

30188 (AED-CONF-74-538-020) MECHANICAL-TECHNOLOGICAL PROPERTIES OF THE BASE MATERIAL AND WELDED ASSEMBLY (EMPIRICAL EXAMINATIONS OF THE STEEL 22 NiMoCr 37). Grossmaas, H.; Mueck, G. H. 1974. 5p. (In German). INIS.

From international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

6 figs.; 3 tabs.; 4 refs. Available from ZAED.

The mechanical-technological properties of 22 NiMoCr 37 steel and its welded assembly are demonstrated. A possible quality assurance program conducted with associated production control is described. (auth)

30189 (AED-CONF-74-538-021) PREVENTION OF UNDERCLAD CRACKING BY HIGH FREQUENCY INDUCTION HEATING. Yamazaki, Y.; Amano, M.; Naiki, T.; Saiga, Y. 1974. 9p. INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

19 figs.; 5 tabs.; 3 refs. Available from ZAED.

Underclad cracking which is found often after post-weld heat treatment occurs at only coarsened grain zone in which the maximum tensile residual stress may exist. Efforts to establish a method to refine these coarsened grain zones by secondary heating prior to PHWT are reported. High frequency induction heating (HFIH) was selected as a preferable method of heating weldments to optimum temperature. The effects of multiple high-frequency induction heating on the mechanical and corrosion properties of weldments made of the steels SA 508 C12 and SA 533 Gr.B C11 and the overlay welding strip metal ASME SFA-5.9 ER-308L were studied. (auth)

30190 (AED-CONF-74-538-029) EVALUATION OF MATERIAL PROPERTIES BY MEANS OF THERMOELECTRIC MEASUREMENTS. Hoffmeister, H.; Austel, W. 1974. 3p. (In German). INIS.

From international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

7 figs.; 3 tabs.; 2 refs. Available from ZAED.

Continuous measurements of integral thermoelectric EMF of hardened steels C 22, 22 NiMoCr 37, and 21 NiCrMoV 47 during annealing in comparison with real EMF are described along with correlations of hardness values. (auth)

30191 (AGC-2275) MATERIALS PROPERTIES DATA BOOK. (Aerojet-General Corp., Azusa, Calif. (USA)). Jul 1964. 667p. Dep. NTIS $36.50.

Data are presented on properties of Nerva reactor materials. Information is included on Al-base alloys, Ti-base alloys, Ni-base alloys, Be-base alloys, Mo-base alloys, steels, and stainless steels. (JRD)

30192 (ANL-8083) COMPATIBILITY OF $UO_2 \cdot ZrO_2 \cdot CaO$ TERNARY OXIDE AND Nb–1 wt % Zr ALLOY. Rough, F. A.; McCuaig, F. D.; Ayer, J. E. (Argonne National Lab., Ill. (USA)). Dec 1974. Contract W-31-109-Eng-38. 19p. AT.

A fast-neutron converter section is to be added to the core of the Transient Reactor for use in fast-reactor safety experiments with clusters of fuel pins. Fuel-selection studies resulted in the choice of $UO_2 \cdot ZrO_2 \cdot CaO$ ternary oxide clad in Nb–1 wt % Zr as the reference. The chemical compatibility of Nb–1 wt % Zr cladding versus $UO_2 \cdot ZrO_2 \cdot CaO$ is good at temperatures up to 2000°C, if the ternary oxide is hydrogen-reduced before use. Test data indicate that it may be possible to limit hardening of the Nb–1 wt % Zr cladding to acceptable levels, if it is exposed to a flowing atmosphere of cold-trapped helium. (13 fig, 5 tables) (DLC)

30193 (COO-1198-1117) BIAS STRESS DETECTION OF DISLOCATION RESONANCE IN LEAD. Read, D. T. (Illinois Univ., Urbana (USA)). May 1975. Contract AT(11-1)-1198. 169p. Dep. NTIS $11.50.

Thesis.

Measurements of the ultrasonic attenuation and velocity and their changes with bias stress were used to test theories of bias stress effects by Hikata, Johnson, and Elbaum (HJE); Hikata and Elbaum (HE); Alefeld; and one presented. The only theory that survives the test and is supported by measurements is the present string theory, according to which the principal effect of the bias stress is to change the average segment length of some of the dislocations from that determined by weak pinning points L_c to that determined by strong pinning points L_N. The fact that the kink models of HE and Alefeld are found to be invalid means that there still exists no direct experimental evidence for kinks on dislocations in crystals. The bias stress technique was applied to a study of dislocation behavior in lead. The principal result found is that dislocations are underdamped in lead in the superconducting state, and also in the normal state. This provides experimental evidence for the inertial model of strength changes in superconductors, which requires underdamped dislocations in both states to fit the observed data, and against the Natsik increased attack frequency model, which requires overdamped dislocations in the normal state. An electronic drag constant is derived of $B_n \approx 2 \times 10^{-6}$ cgs, which is lower than previous estimates, but in good agreement with a recent calculation by Brailsford. The measurements are also used to derive dislocation segment length distribution functions. (auth)

30194 (COO-2212-3) STUDY OF DISLOCATION DYNAMICS ASSOCIATED WITH DUCTILE-BRITTLE TRANSITION AND HYDROGEN EMBRITTLEMENT PHENOMENA OBSERVED IN BCC METALS. Gerberich, W. W.; Atteridge, D. G. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). Mar 1975. 138p. Dep. NTIS $10.00.

Three developments in study of flow and fracture pertain to dislocation dynamics, brittle fracture, and hydrogen-assisted crack growth: Dislocation Dynamics: Stress relaxation at small strains promises to connect up change of strain rate data at large strains to acoustic emission phenomena at very low strains. It was found that logarithmic differentiation of the acoustic emission representation of mobil dislocation density gives an estimate of strain rate sensitivity from $\partial \ln \rho_m / \partial \ln \sigma_\varphi$. This compares favorably with strain rate sensitivity exponents, m′, taken from change of strain rate tests. Brittle Fracture: Ductile–brittle transition analysis points towards a relatively simple criterion for predicting behavior using strain-rate sensitivity, solute-softening, cohesive-energy and fracture mechanics concepts. Initial evaluation of impact and yield data from Fe, Fe–Ni, and Fe–Si alloys indicates that a single parameter, $m_0 \ln[\sigma_f^* - 3\sigma_{ys} / \sigma_u]$DBTT controls cleavage. Here, m_0 is the strain-rate sensitivity exponent, and σ_f^*, σ_{ys}, and σ_u are cleavage, yield, and thermally activated flow stress parameters. Thus far, this parameter separates impact data into the brittle and ductile fracture regimes. Hydrogen Embrittlement: Tests in both cathodically charged and gaseous hydrogen environments are providing evidence for a unified concept of hydrogen-induced slow crack growth. It is shown that increased grain size (d) slows kinetics with growth rate (da/dt) being roughly proportional to $d^{-\frac{1}{2}}$. This tentatively supports theories based upon relatively long-range diffusion of hydrogen to prior austenite grain boundaries. Additional evaluation of cathodically charged specimens has demonstrated that da/dt can decrease with increasing stress intensity during stage II growth. This is explained in terms of

plastic deformation at the crack tip. Crack tip blunting can alter both the severity of the plastic constraint and the position of maximum triaxiality. This effect must be incorporated into all embrittlement theories which have stress-induced diffusion as a major component. (auth)

30195 (COO-3028-13) STUDY OF HYDROGEN PERMEATION THROUGH METALS. Kuehler, C. W. (Princeton Univ., N. J. (USA)). Dec 1974. Contract AT(11-1)-3028. 196p. Dep. NTIS $13.00.

Thesis.

This dissertation is a study of the processes that determine the rate of passage of a gas composed of homonuclear diatomic molecules through a metal membrane into a gas phase of lower pressure. A detailed examination of the available literature revealed that at low temperatures, low driving pressures and for very thin membranes the permeation rate exhibits anomalies not predicted by a theory based on diffusion as the rate-limiting step. Two basic theoretical models were examined in an attempt to describe quantitatively these anomalies. In the first model the rate processes of dissociative chemisorption, penetration of chemisorbed atoms into the surface, diffusion of atoms through the bulk metal, penetration of atoms out of the surface and recombinative desorption were considered. In the second model the presence of a defective oxide film on the surfaces of the metal was postulated. (LK)

30196 (COO-3158-37) FIELD ION MICROSCOPE STUDIES OF SOLUTE ATOMS IN DILUTE Pt ALLOYS. I. Contrast Due to Au, Ni, and W Atoms. Report No. 2343. Chen, C. G.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y. (USA)). Dec 1974. Contract AT(11-1)-3158. 37p. Dep. NTIS $5.00.

Pt-based alloys containing dilute concentrations of either Au, Ni, or W atoms were examined in the field ion microscope during pulsed field evaporation. The contrast patterns produced by the solute atoms were established by comparing the images of the alloy specimens, which contained known concentrations of solute atoms, and the images of pure platinum control specimens. The Au and Ni atoms appeared as α-dark spots, i.e., single dark atomic sites lying within net planes which were visible during all stages of the pulsed field evaporation. In many cases Pt atoms near solute atoms were preferentially field evaporated producing β-dark spots, i.e., single dark atomic sites which appeared suddenly within a well resolved net plane during observation and remained there until all the atoms of that plane evaporated. The W atom contrast was more complex and generally consisted of a cluster of contrast effects which often contained multiple α-dark spots, β-dark spots, and also bright spots. (9 fig) (auth)

30197 (COO-3459-7) FATIGUE OF VANADIUM. Annual Report. Stoloff, N. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). 15 Jan 1975. Contract AT(11-1)-3459. 26p. Dep. NTIS $4.50.

The tensile and fatigue behavior of unalloyed 99.8% vanadium and two vanadium–hydrogen alloys containing vanadium hydride particles were determined at room temperature. In addition, tensile properties of high-purity 99.95% vanadium was determined between 77 and 300°K. S-N data obtained from stress controlled fatigue tests revealed a pronounced improvement in fatigue life for hydrided vanadium. Accompanying increased life was a pronounced change from striated fracture surfaces for unalloyed vanadium to cleavage for the hydrided material. Strain control tests were run to establish Coffin–Manson plots and generate cyclic hardening data for the three 99.8% vanadium materials. Results are discussed in conjunction with metallographic and fractographic observations. (11 figs) (auth)

30198 (D-180-14843) FLAW GROWTH OF VARIOUS NERVA ENGINE MATERIALS. Bixler, W. D. (Boeing Co., Seattle, Wash. (USA). Aerospace Group). Mar 1972. 87p. Dep. NTIS $7.50.

For Aerojet Nuclear Systems Company.

The experimental work described was undertaken to investigate the fracture and flaw growth characteristics of various materials being considered for application on the NERVA nuclear engine. The materials involved include Armco 22-13-5 steel, phosphor bronze, A286 steel, Hastelloy X, 347 stainless steel, 9310 carburized steel, and 5Al-2.5Sn (ELI) titanium. Static fracture test and cyclic life tests (primarily at 5 Hz) were conducted using compact tension specimens. The test environments included 100 psig gaseous helium and hydrogen, 1200 psig gaseous helium and hydrogen, and liquid hydrogen; test temperatures were 70, –160, and –423°F. The gaseous hydrogen used was of high purity. A summary of the results obtained is presented. (auth)

30199 (GEAP-20662) EFFECT OF CONSTRAINT AND LOADING MODE ON LOW-CYCLE FATIGUE CRACK INITIATION; COMPARISON WITH CODE DESIGN RULES. Gerber, T. L. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Oct 1974. Contract AT(04-3)-189. 48p. Dep. NTIS $4.00.

An experimental and analytical investigation of the effect of constraint and loading mode on low-cycle fatigue crack initiation was carried out. Round bar test specimens with circumferential groove and shoulder fillet stress concentrations were fabricated from Type-304 stainless steel and A212 carbon steel. These specimens were fatigue tested in load or deflection-controlled modes of loading, and the cycles required to initiate fatigue cracks were determined. An elastic-plastic finite-element analysis of these specimens was carried out to predict local plastic strains. The fatigue tests showed that both constraint and mode of loading are important to crack initiation. Predicted local strains agreed with measure strains and finite element techniques were shown to be valuable in low-cycle fatigue analyses. Conservatisms and limitations of the current Section III ASME Code rules are pointed out. (30 fig) (auth)

30200 (LBL-3527) DESIGN OF TOUGH FERRITIC CRYOGENIC STEELS. Morris, J. W. Jr.; Jin, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 22p. (CONF-750404-1). Dep. NTIS $4.25.

From the design engineer conference; New York, New York, USA (21 Apr 1975).

It has long been known that ferritic steels would attain high strength levels at cryogenic temperature because of the pronounced thermal contribution to the yield strength of the bcc structure at low temperature. However, this increase in strength typically induces an embrittlement (the ductile–brittle transition) which severely restricts the utilization of available ferritic steels in cryogenic systems. Recent research has shown that this low-temperature embrittlement may be overcome through a careful matching of composition and microstructure. This paper discusses the microstructural features important in a tough cryogenic steel and alloy design techniques illustrated by describing the processing and properties of two new cryogenic steels, of nominal composition Fe–12Ni–0.25Ti and Fe–8Ni–2Mn–0.25Ti. (9 fig, 3 tables) (auth)

30201 (LBL-3595) FUNDAMENTAL CONSIDERATIONS IN THE DESIGN OF FERROUS ALLOYS. Zackay, V. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1975. Contract W-7405-eng-48. 37p. (CONF-750407-1). Dep. NTIS $5.00.

From 40th meeting of the structures and materials panel; Brussels, Belgium (14 Apr 1975).

For ferrous alloys, there is now a wealth of information on the relations between microstructure and fracture toughness. The relations were established by experiment, but they are in accord with theories of defects in solids and of linear elastic fracture mechanics. This state of affairs is probably a consequence of the significant advancements that have been made in fields relevant to alloy design. Mention is made of high resolution electron optical instrumentation for the identification and characterization of the elements of microstructure and of the standardization and perfection of the techniques for the quantitative measurements of the fracture toughness of solids. One major problem now confronting the designer of alloys is that of producing alloys having microstructures with the desirable microconstituents and without the undesirable ones. Its solutions require knowledge of the interactions of elements in metallic solids as they influence the thermodynamics, kinetics, and phase transformations of solids. (20 fig) (DLC)

30202 (RCN-222) FATIGUE CRACK PROPAGATION OF TYPE 304 STAINLESS STEEL (D.I.N. 1.4948) AT ROOM TEMPERATURE AND 550°C. de Vries, M. I.; Staal, H. U. (Stichting Reactor Centrum Nederland, Petten). Jan 1975. 24p. Dep. NTIS (US Sales Only) $4.25.

Fatigue crack growth rates were measured on stainless steel type 304 (DIN 1.4948) at room temperature and 550°C in air. Central crack specimens were tested under uniaxial tension. Tests were performed on a closed loop electro-hydraulic Instron 1251 Universal Testing Machine, in the load control mode. The investigations involved optical measurement of macroscopic fatigue crack propagation, metallographic examination of the microstructure of the material, examination of surface cracking by means of scanning electron microscopy and fractography by means of replica techniques. It was found that macroscopic crack growth rates related to the crack tip stress intensity range obeyed the power law relationship of Paris and Erdogan. Macroscopic crack growth rates at 550°C were higher than at room temperature. Striation spacing measurements are correlated with the stress intensity range for specimens tested at room temperature. The average values of local crack growth rates corresponded very closely to the optical measured macroscopic crack growth rates. (auth)

30203 (TID/SNA-893) MATERIALS DATA RELEASE MEMORANDA. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 2 Mar 1972. 225p. Dep. NTIS $14.25.

The memoranda cover various mechanical and thermal properties of Inconel 718, AISI 347, Al 7039, Ti-5 Al-2.5 Sn ELI, A-286, AA 6061, AISI 301, AISI 9310, phosphor bronze, and Alloy 22-13-5. (DLC)

30204 TOPOGRAPHY AND MICROSTRUCTURE. Dehoff, R. T. (Univ. of Florida, Gainesville). Metallography; 8: No. 1, 71-90 (Feb 1975).

Three levels of description of the geometric state are considered in discussing the "three-dimensional topography" of a microstructure. The first level is simply a list of the features that exist in the structure; the second associates with each member of this list, numbers that describe its extent or configuration; the third is a complete description in terms of the distribution of features in space. Experimentally, most of the metric properties may be estimated from counting measurements made upon a representative microsection; whereas the topological properties require a serial sectioning analysis. The counting measurements are then combined with some elementary statistical analysis in order to describe anisotropies, gradients, and spatial relationships between microstructural features. (auth)

30205 FRAGMENTED TWINS IN Mo-35 at.% Re ALLOY. Mahajan, S. (Bell Labs., Murray Hill, NJ). Scr. Met.; 9: No. 3, IX(Mar 1975).

The crystallographic features of fragmented twins and associated substructures have been correlated by transmission electron microscopy. In three out of the four cases examined, fragmented segments exhibit no lateral displacements with respect to each other, whereas in one situation offset is observed in the absence of glide dislocations whose Burgers vector is not parallel to the twinning vector. In the majority of the cases, fragmentations are envisaged to be obstacle-induced, whereas the latter case is consistent with slip-induced fragmentation hypothesis. Further, in a few cases, it has been possible to identify the obstacles; the origin of these obstacles is also considered. (auth)

30206 CRYSTALLIZATION OF AN AMORPHOUS Cu-Zr ALLOY. Vitek, J. M.; Vander Sande, J. B.; Grant, N. J. (Massachusetts Inst. of Tech., Cambridge). Acta Met.; 23: No. 2, 165-176(Feb 1975).

A Cu-40 at.% Zr alloy was splat cooled into a non-crystalline structure. The crystallization behavior of this alloy was studied by calorimetry, transmission electron microscopy, and hardness testing. Calorimetric studies indicated that crystallization of the initial non-crystalline material occurred by a single exothermic reaction. The heat release was 1260 cal/mole and occurred at 480°C. Evidence for a glass transition at ~450°C was also found. Samples previously isothermally annealed below the crystallization temperature exhibited two exothermic reactions when studied calorimetrically. The additional second peak increased in size and shifted to temperatures higher than the first peak with increased annealing. Transmission electron microscopy indicated that crystallization occurred by a nucleation and growth mechanism during isothermal annealing. The crystallites were found to have a fine substructure with a subgrain size of ~300-500 Å. The crystallization product was single phase. Calorimetry results, direct observations from transmission electron microscopy, and changes in the electron diffraction pattern of annealed samples led to the conclusion that the initial non-crystalline matrix transforms to a second non-crystalline structure which, in turn, transforms to the crystalline phase. Hardness measurements were performed to follow the crystallization process. Results indicated that hardness monitors the transformation of the initial non-crystalline structure with high sensitivity. (auth)

30207 GRAIN SIZE DEPENDENCE OF THE DEFORMATION BEHAVIOR OF CADMIUM. Mannan, S. L.; Rodriguez, P. (Bhabha Atomic Research Centre, Trombay, India). Acta Met.; 23: No. 2, 221-228(Feb 1975).

The grain size dependence of the yield and flow stresses of cadmium in the temperature range 77-298 K was investigated by combining Hall-Petch analysis with thermal activation strain rate analysis. Results from temperature cycling tests showed that the Hall-Petch intercept $\sigma_{0\epsilon}$ is essentially athermal in nature, while the Hall-Petch slope K_ϵ contains, in addition to the thermal component of flow stress, a contribution from the athermal component. Activation areas were determined from strain rate change tests and were found to vary linearly with the square root of the grain size. $\sigma_{0\epsilon}$ was found to increase with strain at all temperatures. At 77 and 196 K, the Hall-Petch slope K_ϵ was found to first increase with strain, pass through a maximum at 7% strain at 77 K and at 4% strain at 196 K, and then decrease with strain. At 255 and 298 K, K_ϵ was found to decrease continuously with strain. Both $\sigma_{0\epsilon}$ and K_ϵ were found to decrease with increasing temperature. The variations in $\sigma_{0\epsilon}$ and K_ϵ with strain and temperature have been examined in the light of the various physical models for the Hall-Petch equation. (auth)

30208 SIMPLE MODEL FOR GRAIN REFINEMENT DURING SOLIDIFICATION. Maxwell, I.; Hellawell, A. (Oxford Univ.). Acta Met.; 23: No. 2, 229-237(Feb 1975).

Assuming: (1) a spatially isothermal melt; (2) a heterogeneous nucleation rate according to the classical theory; (3) spherical diffusion controlled growth, the number of heterogeneous nucleation events that occurs during the initial stage of a liquid → solid reaction has been computed as a function of nucleant particle density using Al-Ti as the model system. The influence of cooling rate, substrate activity, and alloy constitution has been investigated, the last by comparison with the refinement obtainable in the systems Al-Zr and Al-Cr. The predictions of the model are in acceptable accord with observed behavior considering the necessary assumptions of the model. (auth)

30209 ELASTIC INTERACTION BETWEEN A SYMMETRIC POINT DEFECT AND A DISK CLUSTER IN ANISOTROPIC CUBIC CRYSTALS: GUINIER-PRESTON ZONES IN BERYLLIUM COPPER. Millar, D. J. (Lube Systems, Paramount, CA); Sines, G.; Goodman, J. W. Acta Met.; 23: No. 2, 245-253(Feb 1975).

The elastic interaction between a disk with a thickness misfit on the (100) plane and a symmetric point defect in a cubic anisotropic crystal is calculated, and energy contours for beryllium in copper are presented. The interaction field consists of two polar regions and an equatorial region separated by a potential barrier, which contrasts with the unseparated field for isotropic or hexagonal crystals. The morphology of Guinier-Preston zones and their growth rates are discussed with respect to the effect of the interaction on solute atoms and vacancies. For beryllium in copper, the interaction favors the formation of stacked G.P. zones which recently have been reported. (auth)

30210 LOW TEMPERATURE DEFORMATION CHARACTERISTICS OF GROUP Va METAL-HYDROGEN SINGLE CRYSTALS. Chen, C. C.; Arsenault, R. J. (Univ. of Maryland, College Park). Contract AT(40-1)-3612. Acta Met.; 23: No. 2, 255-267(Feb 1975).

An investigation was undertaken to determine the influence of hydrogen on the low temperature deformation characteristics of Group Va metal single crystals in a temperature range 20-473 K. High purity vanadium, niobium and tantalum containing hydrogen exhibit low-temperature perturbations in the temperature dependence of their yield stresses. On the basis of an analysis of the activation parameters, and the fact that the local perturbation in the temperature dependence of yield stress occurs at critical temperatures and below the solvus, a mechanism which could explain the results is the stress-induced reorientation of the hydride platelets due to the stress fields of the moving dislocations. Additional observations were made to demonstrate that neither precipitation hardening nor a trapping phenomenon can account for the local perturbation in the temperature dependence of yield stress. (auth)

30211 EFFECT OF OXYGEN, NITROGEN, AND HYDROGEN ON THE MECHANICAL PROPERTIES OF Cb-752. Mahoney, M. W.; Paton, N. E. 74-Mat-T. New York; American Society of Mechanical Engineers (1974). 6p. $1.00.

Uniaxial tensile properties of the niobium base alloy Cb-752 were determined as a function of oxygen, nitrogen, and hydrogen content over a temperature range of -196 C to 200 C. Each of these impurities increased the temperature at which a ductile-brittle transition occurs. Although ductility was severely reduced, strength parameters were relatively unchanged, making detection of embrittlement by hardness testing difficult. Impurity levels for embrittlement were sufficiently low and the affinity of Cb-752 for contamination sufficiently great that processing operations require strict control. The mechanism of this impurity embrittlement is not well understood. However, observations of fracture surfaces of brittle failures reveal mixed intergranular cleavage with a uniform distribution of precipitates throughout grain boundaries. These observations are discussed in the light of current theories. (auth)

30212 STRESS-RUPTURE OF EPOXY-COATED BERYLLIUM WIRE. Chiao, T. T.; Hamstad, M. A.; Jessop, E. S. (Univ. of California, Livermore). J. Compos. Mater.; 8: No. 4, 405-410 (Oct 1974).

Stress-rupture data for uniaxial tension loading was obtained for a fiber composite of Be wire and a liquid epoxy system containing Dow DER 332, Union Carbide ERL-4206, and Celanese Epi-Cure 855. The following characteristics were noted: (1) a single monofilament Be/epoxy composite has stress rupture life properties similar to Kevlar 49 epoxy composites; (2) at stress levels between 75% and 90% of ultimate, a decrease in stress by

5% will increase the life of the Be/epoxy by about a factor of 5; and (3) the Be/epoxy stress rupture data has less scatter than S-glass, Kevlar 49, and Thornel 50 S due to its lower tensile strength variation. (PMA)

30213 IMPERFECTIONS AND MICROSTRUCTURE. Mitchell, J. B. (Univ. of California, Livermore). Metallography; 8: No. 1, 5-70(Feb 1975).

Basic descriptions are presented of the nature and behavior of structural imperfections in crystalline materials. In particular, attempts were made to illustrate the role of these structural imperfections in developing some of the microstructural features which are commonly observed. Some attention is given to surface features of the microstructure, but primary concern is directed toward the microstructures achieved via transmission electron microscopy. (auth)

30214 STRUCTURE AND STRENGTH OF ALLOY STEELS. Honeycombe, R. W. K. Greenwich, CT; Climax Molybdenum Co. Ltd. (1975). 36p.

The behavior of some simple alloy steels are examined and compared in the quenched and tempered state with the directly transformed state. In each case the final structure is a dispersion of an alloy carbide in ferrite, but the detailed structures are quite different. The influence of the common carbide forming elements on tempering behavior is summarized, but much remains to be understood about inter-element effects in more complex compositions. The role which several elements play in direct decomposition of austenite are explored, and ways in which new steels could be developed to fully exploit the observed structures are outlined. (PMA)

30215 THERMODYNAMIC STUDIES OF THE $\alpha \rightarrow \beta$ PHASE TRANSFORMATION IN ZIRCONIUM USING A SUBSECOND PULSE HEATING TECHNIQUE. Cezairliyan, A.; Righini, F. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 79A: No. 1, 81-84(1975).

Measurements of the temperature and energy of the $\alpha \rightarrow \beta$ phase transformation, and the electrical resistivity near and at the transformation point of zirconium using a subsecond duration pulse heating technique are described. The results yield 1147 K for the transformation temperature and 3980 $J \cdot mol^{-1}$ for the transformation energy. Electrical resistivity is found to decrease by 17% during the transformation. Estimated inaccuracies of the measured properties are: (1) 10 K for the transformation temperature; (2) 5% for the transformation energy; and (3) 2% for the electrical resistivity. (auth)

30216 EQUILIBRIUM IN HYDRIDE FORMATION IN TANTALUM. Lecocq, P.; Wert, C. (Univ. of Illinois, Urbana). Thin Solid Films; 25: No. 1, 77-84(Jan 1975).

The rate of formation of hydrides in tantalum is shown to depend markedly on the rate of diffusion of hydrogen in the metal. Oxygen slows the rate of reaction considerably; this is apparently a result of trapping of hydrogen in O-H complexes. Deuterides form more slowly than hydrides because of the lower rate of diffusion of deuterium in the metal. A summary is made of some of the thermodynamic properties of hydrogen and deuterium in Ta, Nb and V. This summary shows that binary alloys with Ta and Nb have many similarities, but V-H and V-D alloys show some differences from the other two. (auth)

30217 SURFACE SELF-DIFFUSION OF SINGLE ATOMS. Graham, W. R.; Ehrlich, G. (Univ. of Illinois, Urbana). Thin Solid Films; 25: No. 1, 85-96(Jan 1975).

The surface transport of atoms plays an important role in the growth of crystals from the vapor. Using the field ion microscope it was possible to establish quantitatively the diffusion parameters for rhodium atoms on different planes of their own crystal, as well as for tungsten atoms on tungsten. On rhodium, an f.c.c. metal, major variations in the diffusion barrier are simply correlated with the atomic arrangement of the surface: smooth planes have a low activation energy, rough planes a high one. On tungsten such trends are not apparent, but on both metals the dynamics of motion are normal. Quite a different behavior is found for the diffusion of doublets, which have been studied in detail on the (211) plane of tungsten. Motion occurs over a low activation barrier, but with a low frequency factor, by the advance of one atom at a time. Triplets have been found to behave in precisely the same way. (auth)

30218 TEMPERATURE DEPENDENCE OF THE CROSS SECTION FOR ELECTRON SCATTERING BY DISLOCATIONS IN METALS. Gantmakher, V. F.; Kulesko, G. I. (Inst. of Physics of Low Temperature, Kharkov). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2335-2340(Dec 1974). (In Russian).

The temperature dependence of the additional electric resistance resulting from dislocations introduced into the metal is studied in single crystal and polycrystalline copper, molybdenum and zinc samples. In all cases the dependence is of a step-like shape, the position of the step on the temperature scale being independent of the degree and mode of deformation. The possibility that a dependence of this type may be due to variation of the cross section for electron scattering produced by the dislocations themselves is discussed. It may occur either through inelastic scattering induced by quasilocal modes or through the elastic part altered as a result of filling up of electron levels localized at the dislocations. (auth)

30219 HIGH TEMPERATURE DEFORMATION OF ZIRCONIUM AND ZIRCONIUM-TIN ALLOYS. Luton, M. J. Montreal; McGill Univ. (1971). 272p.

Thesis.

Compression tests were carried out on polycrystalline samples of α-zirconium and zirconium-tin alloys. The tests were performed between 625°C and 925°C and at strain rates from 10^{-4} to 1 s^{-1}. Both yield and steady state stresses were determined and found to be strongly strain rate and temperature sensitive. At low temperatures and high strain rates, the yield stress was nearly independent of strain rate and temperature, indicating a shift to athermal deformation. Activation analysis of the experimental data led to activation areas in the range 1000 to 100b^2, which decreased rapidly with stress but only slightly with tin content. The analysis indicated that a particular aspect of the intersection process is likely to be rate controlling. The strengthening effect of tin is attributed to an accompanying decrease in stacking fault energy, leading to increases in the work of intersection. The increase in flow stress from yield to the steady state regime was attributed to an increase in substructure density, leading to an increase in internal stress. The activation entropy for high T flow is discussed and a comparison is made between the activation parameters pertaining to empirical stress laws and the conventional rate equation. (auth)

30220 HARDENING OF ALLOY TsM2A BY INTERNAL NITRIDING. Levinskii, Yu, V.; Buntushkin, V. P.; Khvostikov, V. D. (Moscow Inst. of Steel and Alloys). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 7-8, 611-613(1974).

Translated from Metalloved. Term. Obrab. Metal.; 16: No. 7, 64-66(Jul 1974).

Precipitation hardening by internal nitriding was examined in alloy TsM2A (Mo-0.17Ti-0.12Zr). Tensile properties were determined at various temperatures (1100-1700°C) for samples in the original (deformed) condition, after vacuum annealing, and after nitriding. Nitrided samples showed generally higher yield strengths than the deformed samples, which showed generally higher strengths than the recrystallized specimens. Nitrided samples also showed a greater microhardness than recrystallized samples in tests from 20 to 1100 C. (PMA)

30221 Ti ALLOY HARDENED BY CARBONITRIDING. Bogomolov, V. A.; Govorov, A. A.; Kuznetsov, L. I. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 7-8, 633-635(1974).

Translated from Metalloved. Term. Obrab. Metal.; 16: No. 7, 79-80(Jul 1974).

After carbonitriding of alloy VT3-1 at 920°C for 24 h, a case 0.35-0.45 mm deep is formed, which consists of carbonitride to a depth of 0.01 mm, $\alpha + (\alpha + \beta)$ phases at depths over 0.03 mm. The distribution of nitrogen and carbon through the case corresponds to the change in the microhardness, which confirms their basic effect on hardening of the surface layer. In the process of carbonitriding, the alloying elements (Al, Cr, Mo) are redistributed through the case in conformity with their tendency to stabilize the α or β phases. Carbonitriding substantially increases the wear resistance of the alloy. However, the use of carbonitriding is recommended only in the case where the operating conditions do not require high ductility of the alloy. (PMA)

30222 PHASE DIAGRAMS OF Fe ALLOYS WITH Zr AND Hf CARBIDES. Shurin, A. K.; Dmitrieva, G. P. (Inst. of Metal Physics, Kiev). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 7-8, 665-667(1974).

Translated from Metalloved. Term. Obrab. Metal.; 16: No. 8, 27-28(Aug 1974).

Structure and phase studies were made for iron alloys with zirconium and hafnium carbides. The following characteristics were observed: (1) the carbide eutectic in Fe-ZrC and Fe-HfC alloys consists primarily of lamellar colonies; (2) the primary crystals of zirconium and hafnium carbides in alloys with iron may be cubic or dendritic in form; and (3) quasibinary phase diagrams of iron with zirconium and hafnium carbides are of eutectic type. (PMA)

30223 PHYSICO-CHEMICAL STUDY OF THE ELECTROLYTIC ALLOY COBALT-MOLYBDENUM. Malyakina, A. G.; Karavaev, V. B.; Bol'shakov, A. F.; Ozerov, A. M. (Volgograd Inst. of Municipal Engineers). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 18: No. 1, 153-154(1975). (In Russian).

An x-ray phase study was made of samples of Co–Mo alloys obtained at different forms of current. The effect of the different forms on the microhardness of the deposition was determined. (tr-auth)

30224 STRUCTURAL CHANGES IN COMPOSITE MATERIALS WITH Fe-BASE AND Ni-BASE MATRIXES. Savchuk, A. N.; Ol'shanetskii, V. E.; Banas, F. P.; Myal'nitsa, G. F. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 7-8, 700-702(1974). Translated from Metalloved. Term. Obrab. Metal.; 16: No. 8, 63-66(Aug 1974).

Secondary recrystallization occurs at the contact between specially alloyed molybdenum filaments and a Nichrome matrix. An intermetallic zone as much as 12μ wide with a high hardness is formed at the boundary with the matrix. In a Fecraloy matrix the alloyed molybdenum filament does not recrystallize and the addition of powdered Cr–W–Mo alloy prevents formation of a brittle intermetallic layer at the boundary. The addition of the powdered Cr–W–Mo alloy to the Nichrome matrix restrains secondary recrystallization processes in the molybdenum filament. The transition zone at the matrix-filament interface has a low microhardness. The powdered Ni–W–Mo alloy activates secondary recrystallization of the molybdenum filament in the Nichrome–molybdenum and Fecraloy–molybdenum composites. This indicates that nickel lowers the stability of the structure of molybdenum with holding at elevated temperatures. (PMA)

30225 MAGNETIC PROPERTIES OF INTERMETALLIC COMPOUNDS OF COPPER WITH THE LANTHANIDES. Basha, A. F.; Chechernikov, V. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 5, 613-615(1974). (In Russian).

Intermetallic compounds of Y, La, Ce, Nd, Gd, Tb, and Dy with Cu were prepared with the composition 1:1, 1:2, and 1:5. The magnetic properties were measured in the temperature interval from 77 to 800°K and at magnetic field intensities from 2 to 8 kOe. The results showed that all compounds of Y and La are temperature-independent paramagnetic. The compound TbCu is antiferromagnetic, but in the other compounds of this composition, the magnetic susceptibility follows the Curie-Weiss law. Deviations from the Curie-Weiss law are found in DyCu, GdCu, $TbCu_2$, and $GdCu_2$. All other RCu_2 and RCu_5 compounds follow this law. The size of the antiferromagnetic interactions in all the compounds studied essentially depends on the stoichiometry and the crystalline type. (JSR)

30226 MICROTENSILE BEHAVIOR OF MOLYBDENUM. Von Rinnerthaler, W.; Benesovsky, F. (Metallwerk Plansee AG, Reutte, Austria). Planseeber. Pulvermet.; 21: No. 4, 253-270(Dec 1973). (In German).

The microtensile behavior of molybdenum single crystals was investigated as a function of orientation and impurity content, using an inductive extensometer. The orientation dependence in the microtensile region is analogous to the macroscopic tensile properties. This cannot be explained by a critical shear stress law. The influence of the impurities is large, but probably only of a secondary nature (hardening). An interpretation of the experimental results is attempted on the basis of the different dislocation models. A reasonable explanation of the observed orientation effects is obtained on the assumption that the deformation behavior of molybdenum is determined by jogged dislocations. Thus, conservative dislocation motion is possible only in the glide planes stressed by jogs. Gliding takes place only when the Schmid-Factor in these planes differs from zero. (auth)

30227 DIFFUSION MECHANISMS FOR THE GROWTH OF Nb_3Sn INTERMETALLIC LAYERS. Farrell, H. H. (Bell Labs., Murry Hill, NJ); Gilmer, G. H.; Suenaga, M. Thin Solid Films; 25: No. 1, 253-264(Jan 1975).

The analysis of compound formation in a diffusion couple previously developed by the authors is extended to include the effect of interface kinetics. When interface kinetics dominate, a linear rate law may be obtained rather than the parabolic rate law expected if simple bulk diffusion were the rate-limiting process. Additional data for the rate of formation of Nb_3Sn at a bronze–niobium interface are presented. Results imply that interface kinetics are important when the concentration of Sn in the bronze matrix exceeds about 8 at.% or when certain metallic impurities are present in the niobium. (auth)

30228 HARDNESS BEHAVIOR OF BINARY AND TERNARY NIOBIUM ALLOYS AT 77 AND 300 K. Stephens, J. R.; Witzke, W. R. (Lewis Research Center, Cleveland). J. Less-Common Metals; 40: 195-205(1975).

An investigation was conducted to determine the effects of alloy additions of zirconium, hafnium, molybdenum, tungsten, rhenium, ruthenium, osmium, rhodium, and iridium on the hardness of niobium. Both binary and ternary alloys were investigated by means of hardness tests at 77 and 300 K. Results showed that atomic size misfit plays a dominant role in controlling the hardness of binary niobium alloys. Alloy softening, which occurred at dilute solute additions, is most likely due to an extrinsic mechanism involving interaction between solute elements and interstitial impurities. (auth)

30229 SUPERCONDUCTIVITY IN AMORPHOUS AND MICROCRYSTALLINE TRANSITION–METAL ALLOYS. Johnson, W.L.; Poon, S.J. (W. M. Keck Laboratory of Engineering Materials, California Institute of Technology, Pasadena, California 91109). J. Appl. Phys. 46: No. 4, 1787-1792 (Apr 1975).

Results of x–ray diffraction, electrical resistivity, critical magnetic field, and transport measurements for several bulk amorphous and microcrystalline transition–metal superconductors obtained by liquid quenching are presented and discussed. Simple $J_c-H_{c2}-T_c$ relations are observed for this class of materials. A linear relation between electronic diffusivity and nearest–neighbors distance is derived from critical field measurements. The relationship between the formation of an amorphous phase by rapid cooling from the liquid state, lattice stability, and the characteristics of phase diagrams are discussed. (auth)

30230 SUPERCONDUCTIVITY OF Nb–Ru ALLOYS SYNTHESIZED AT HIGH PRESSURE. Popova, S.V.; Fomicheva, L.N.; Pal'nikov, N.I. (Institute of High–Pressure Physics, USSR Academy of Sciences). JETP Lett. 20: No. 10, 298-299 (20 Nov 1974).

We synthesized at high pressure two intermetallic phases with composition close to $NbRu_3$, an α phase with structure of the Cu_3Au type (a=3.88 Å), and a γ phase with hexagonal close–packed structure (a=2.74 Å, c=4.40 Å). The superconducting–transition temperatures of the α and γ phases were T_c=15–16 °K and 11–12 °K respectively. (auth)

30231 EXPERIMENTAL STUDY OF μ ACOUSTOCONDUCTIVITY IN n-TYPE INDIUM ANTIMONIDE. Ivanov, S.N.; Mansfel'd, G.D.; Khazanov, E.N. (Institute of Radio Technology and Electronics, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Solid State 16: No. 8, 1503-1505 (Feb 1975).

The increase in the electrical conductivity of n-type InSb crystals at liquid-helium temperature under the influence of acoustic waves in weak electric fields is studied. By comparing the experimental data with theory it is concluded that certain mechanism are responsible for the scattering of the electrons, and the relaxation time τ_{en} of the electron energy is determined as a function of the electron temperature. In strong electric fields the conductivity diminishes under the influence of ultrasound. (auth)

30232 TWO–PHASE EQUATION OF STATE AND FREE–ENERGY MODEL FOR DYNAMIC PHASE CHANGE IN MATERIALS. Kamegai, M. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Appl. Phys. 46: No. 4, 1618-1624 (Apr 1975).

This paper describes the free–energy approach to calculating the dynamic phase change induced by shock waves. A thermodynamic model is developed for the nonequilibrium phase change assuming that the rate of transition is determined by the difference in the Gibbs free energy among all the phases present and that the transition proceeds toward the phase of the lowest free energy. A two–phase equation of state is derived for the Hugoniot states with the pressure and temperature as independent variables. In order to demonstrate the validity of the theory, the analysis of experimental results is made by applying the free–energy model. It is found that in highly ompressible solids. e.g., bulk modulus 280 kbar and 14% change in density at the transition pressure for δ–plutonium, there is no sharply defined transition point. Instead, the transition takes place gradually at the rate increasing with pressure up to the transition point where the process completes very rapidly. *DP/DT* taken at the transition point is a variable input in the present scheme. The slope of the phase boundary at the transition pressure is determined from *DP/DT*. The importance of the phase boundary for the shock–loading and shock–unloading processes is explained. (auth)

30233 ELASTIC CONSTANTS OF TUNGSTEN–RHENIUM ALLOYS FROM 77 TO 298 °K. Ayres, R.A.; Shannette, G.W.; Stein, D.F. (Department of Metallurgy, Michigan Technological University, Houghton, Michigan 49931). J. Appl. Phys. 46: No. 4, 1526-1530 (Apr 1975).

The adiabatic single–crystalline elastic constant of W–3 at.% Re and W–10 at.% Re were measured in the temperature range 77–298 °K. The elastic anisotropy ratio, C_{44}/C, was found to follow the behavior predicted by Fisher for transition–metal alloys. Re additions to W decrease the elastic constant C which indicates decreasing stability of the bcc structure. This behavior is believed to be related to the d–band structure. The Debye temperature for alloys was calculated and found not to vary appreciably from the value for pure W. (auth)

30234 ELASTIC CONSTANTS OF POLYCRYSTALLINE α –URANIUM. Abey, A.E.; Bonner, B.P. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Appl. Phys. 46: No. 4, 1427-1428 (Apr 1975).

The elastic constants of polycrystalline α-uranium were determined as a function of pressure *P*. Measurements were made in the range from 100 kPa to 1.8 GPa. The initial Lamé constant λ is 53 GPa, the initial shear modulus μ is 86 GPa, and the bulk modulus is 110 GPa. The value for $d\mu/dP$ is 2.99. This is the largest $d\mu/dP$ reported thus far for any element. (auth)

30235 / MAGNETIC EXCITATIONS AND MAGNETIC ORDERING IN PRASEODYMIUM. Houmann, J.G.; Chapellier, M.; Mackintosh, A.R. (Danish Atomic Energy Research Establishment, Risø, Denmark); Bak, P.; McMasters, O.D.; Gschneidner, K.A. Jr. Phys. Rev. Lett. 34: No. 10, 587-590 (10 Mar 1975).

The dispersion relations for magnetic excitons propagating on the hexagonal sites of double-hcp Pr provide clear evidence for a pronounced anisotropy in the exchange. The energy of the excitations decreases rapidly as the temperature is lowered, but becomes almost constant below about 7 K, in agreement with a random-phase-approximation calculation. No evidence of magnetic ordering has been observed above 0.4 K, although the exchange is close to the critical value necessary for an antiferromagnetic state. (auth)

30236 THERMAL CONDUCTIVITY OF THE ELEMENTS: A COMPREHENSIVE REVIEW. Ho, C.Y.; Powell, R.W.; Liley, P.E. (Thermophysical Properties Research Center, Purdue University, West Lafayette, Indiana 47906). J. Phys. Chem. Ref. Data, Suppl. 3: No. 1, 1-796 (Dec 1974).

This work presents and discusses the available data and information on the thermal conductivity of the elements and contains the recommended reference values resulting from critical evaluation, analysis and synthesis of the available data and information. It also gives estimated values, at least for normal temperature, for all those elements for which no thermal conductivity information is available. Experimental thermal conductivity data are available in the world literature for 82 elements and estimated values for four other elements. Estimated values for the remaining 19 elements are given here, although only rough estimates are given for the trans-plutonium elements. Thus, this work provides recommended or estimated thermal conductivity values for all the 105 elements. This work is published in two companion versions: this comprehensive volume and an abridged version. In addition to the recommended and estimated thermal conductivity values for elements, the comprehensive volume presents the original data, specimen characterization, and measurement information for the 5200 sets of raw data compiled; contains a detailed discussion for every element reviewing the individual pieces of available data and information together with the considerations involved in arriving at the final assessment and recommendations, and with the theoretical guidelines or semi-empirical correlations on which the critical evaluation, analysis, and synthesis are based; and includes also the complete bibliographic citations for the 1658 references. The abridged version contains only the recommended and estimated thermal conductivity values. (auth)

30237 STRESS REORIENTATION OF HYDRIDES IN ZIRCONIUM-2.5% NIOBIUM. Hardie, D.; Shanahan, M. W. (Newcastle Upon Tyne Univ. (UK)). J. Nucl. Mater.; 55: No. 1, 1-13 (Jan 1975).

By tests on both plate material and specimens cut from tubing, an extensive assessment of the factors governing the realignment of hydride platelets in Zr-2.5 Nb under stress was carried out. Stress reorientation readily occurs providing that the fabrication texture of the material results in a high concentration of basal poles in the direction of applied stress. The results clearly demonstrate that only hydride taken into solution can become reoriented, because the stress affects precipitation during cooling under stress, and the maximum degree of reorientation is therefore dependent upon temperature and hydrogen content. The function of stress is to compensate for the lattice strain that occurs when hydride is precipitated and the degree of reorientation is readily described by an equation derived from a consideration of nucleation frequencies in different directions. (auth)

30238 INTERSTITIAL HELIUM CLUSTERING IN MOLYBDENUM; EFFECT ON SURFACE BLISTERING. Caspers, L. M.; van Veen, A.; van Dam, H. (Technische Hogeschool Delft (Netherlands)). Phys. Lett., A; 50: No. 5, 351-352(30 Dec 1974).

Calculated results are reported which indicate the possibility of clustering of interstitial helium in molybdenum. The possible relation of this clustering with surface blistering is discussed. (auth)

30239 INVESTIGATION OF THERMODYNAMIC PROPERTIES OF BCC SOLID SOLUTIONS OF URANIUM. II. The Uranium-Niobium System. Vambersky, Yu. V.; Udovsky, A. L.; Ivanov, O. S. (AN SSSR, Moscow. Inst. Metallurgii). J. Nucl. Mater.; 55: No. 1, 96-108(Jan 1975).

The physical basis is presented of the model on which calculations of solid solution thermodynamic functions are based, and the relevant physical characteristics of γ-uranium-niobium solid solutions. The excess entropy and enthalpy of mixing at 1100 K are calculated for these alloys. Results are presented of an experimental study of the thermodynamic properties of U-Nb solid solutions in the temperature range from 1048 to 1173 K, by measuring EMF in a molten-salt electrolyte. For entropy of mixing the experimental data are closely consistent with the calculated curve, but there is no such agreement for the enthalpy of mixing. The reasons for this are considered. The possibility of the formation of an intermediate phase in the U-Nb system is briefly discussed. (auth)

30240 STRAIN AGEING IN ZIRCONIUM ALLOYS. Veevers, K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Materials Div.). J. Nucl. Mater.; 55: No. 1, 109-110(Jan 1975).

Results of strain ageing tests on zirconium alloyed separately with tin, iron, nickel and chromium, the alloying elements in Zircaloy-2, are described. In this way, it was hoped to get a better understanding of the strain ageing behavior of Zircaloy-2. Binary alloys of nominal composition Zr-1.5 wt % Sn, Zr-0.15 wt % Fe, Zr-0.05 wt % Ni and Zr-0.10 wt % Cr, were made by argon arc-melting the required weights of crystal bar zirconium and the respective spectrographically pure alloying elements. The temperature dependence of strain ageing is shown. The results strongly support an earlier suggestion that Fe is responsible for strain ageing in Zircaloy-2 at ~450°C. (auth)

30241 EFFECT OF STRESS AND PLASTIC DEFORMATION ON THE TRANSFORMATION OF THE DELTA PHASE IN A Pu-1 AT% Ga ALLOY. Goldberg, A.; Rose, R. L.; Shyne, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). J. Nucl. Mater.; 55: No. 1, 33-52(Jan 1975).

The influence of elastic and plastic deformation on the transformation of the fcc δ phase in a Pu-1 at. % Ga alloy was investigated. Undeformed, this phase could be retained without decomposition for over 17 months at 23°C. An M_s at 8°C is indicated, below which the δ to α transformation starts instantaneously. Transformation to the monoclinic α phase above 8°C could be induced by compressive elastic loading. At room temperature, transformation was induced only by plastic deformation: both the α and orthorhombic γ phases formed with up to a 20% decrease in volume. Different martensite morphologies and variations in the amount of transformation and in the transformation kinetics were obtained depending upon the temperature and condition of loading. (auth)

30242 CRYSTAL STRUCTURE OF THE INTERMETALLIC COMPOUND Eu_3Pd_2. Iandelli, A.; Palenzona, A. (Univ., Genoa). J. Less-Common Metals; 40: 263-264(1975).

On the basis of possible isomorphism between Eu_3Pd_2 and Er_3Ni_2, whose structures had been determined previously, an intensity calculation was carried out. All the reflections agreed well, indicating that both compounds have the same structure. The interatomic distances are calculated to be: shortest Eu-Eu, Eu-Pd, and Pd-Pd distances are 3.62, 3.32, and 2.68 Å, respectively. (DLC)

30243 $ZrAlPt_2$ AND $HfAlPt_2$ PHASES. Ferro, R.; Marazza, R.; Rambaldi, G.; Saccone, A. (Univ., Genoa). J. Less-Common Metals; 40: 251-252(1975).

Hexagonal $Zr(Hf)AlPt_2$ phases were found in Zr(Hf) - Al - Pt ternary alloys of the stoichiometric ratio 1:1:2. $ZrAlPt_2$ was indexed on the basis of a hexagonal cell with a = 4.267 Å, c = 8.611 Å, c/a = 2.018. $HfAlPt_2$ was isostructural, with a = 4.250, c = 8.570 Å, c/a = 2.017, D_x = 14.75 g/cm³. (DLC)

30244 MAGNETIC INVESTIGATIONS OF SOME INTERMETALLIC COMPOUNDS CONSISTING OF RARE EARTH METALS WITH Fe, Co, OR Pt. Miskinis, E. T. Pittsburgh; Univ. of Pittsburgh (1974). 108p. University Microfilms Order No. 75-6374.

Thesis (Ph. D.).

Saturation magnetization, magnetization versus temperature and lattice parameters are presented for the ternary alloys $Gd_{1-x}Th_xFe_2$, $Gd_{1-x}Ce_xFe_2$, and $R_{1-x}Th_xCo_5$ (R = Ce, Pr, Nd). Quadrivalent Th and Ce were introduced into the lattice in an effort to induce ferromagnetic Gd-Fe coupling and ferrimagnetic R-Co coupling. Experiment showed that the antiferromagnetic Gd-Fe coupling in $GdFe_2$ and the ferromagnetic R-Co coupling in RCo_5 are preserved in the ternaries. The Fe moment, Co moment, and Curie temperature decrease as the Gd or R content of the sample is decreased. This is ascribed to electron transfer from Th or Ce to the Fe or Co d-shell. Failure to achieve ferromagnetic and ferrimagnetic coupling is ascribed to electron capture by iron, or cobalt, which prevents a rise in electron concentration as Gd or R is replaced by Ce or Th. Cerium in the $Gd_{1-x}Ce_xFe_2$ system did not show typical tetravalent behavior. Therefore a study of the $Ce_{1-x}Th_xFe_2$ was undertaken to observe the valence of cerium in the presence of tetravalent thorium. For x = .3, .4, and .5, a magnetic anomaly occurred. At low

temperatures, 4.2 K to 100 K, the magnetization was low, but at a temperature range from 100-300 K, a maximum in the magnetization occurred. If these ternaries were cooled from 300 K to 4.2 K in the absence of a field, a larger magnetic moment was present at 4.2 K, but the instant a field was applied, the moment dropped to its lowest value. At this time a good explanation could not be presented for this strange behavior. Further low temperature investigations will have to be conducted before a theory can be proposed. Some antiferromagnetic materials were studied to complete this investigation, $HoPt_3$, $DyPt_3$, and $TbPt_3$. All three compounds possess Néel temperatures below 20 K and effective moments in the paramagnetic region with deviations of less than 5% from the theoretical effective moments. (Diss. Abstr. Int., B)

30245 STUDY OF THE ELECTRICAL RESISTIVITY OF ZONE-REFINED TUNGSTEN AT HIGH TEMPERATURES. Williams, R. K. (Oak Ridge National Lab., TN). J. Appl. Phys.; 46: No. 2, 475-490(Feb 1975).

The electrical resistivity ρ of a zone-refined tungsten sample (residual resistivity ratio 7×10^4) was determined between 1100 and 2500°K. The data are accurate to about 1%; and comparison with other ρ data indicates that the error analysis may be pessimistic. The effects of thermionic charge transport on the ρ data and the performance of uninsulated $W_{97}Re_3 : W_{75}Re_{25}$ thermocouples were also investigated. Comparison of the data with standard transport theory indicates that most of the nonlinear ρ behavior observed at high temperatures is due to thermal expansion effects. (14 figs, 7 tables, 41 references) (DLC)

30246 EVAPORATION RATE FROM AN OPEN SURFACE IN VACUUM AND THE EVAPORATION FACTOR OF COBALT AND SAMARIUM. Fedichkin, G. M. (Moscow Inst. of Electronic Industry). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 46-49 (1974). (In Russian).

The evaporation rate of Co and Sm were measured in a vacuum of 1×10^{-7} to 5×10^{-5} mm Hg at temperature intervals of 1233 to 1395°K and 1360 to 1480°K. The vapor pressures of the two metals were also determined. The evaporation heats were calculated and compared with values obtained by the Knudsen method and the Langmuir method. (JSR)

30247 SINGULARITIES OF RAPID CRYSTALLIZATION OF BINARY ALLOYS IN THE CONCENTRATION REGION FOR THE EXISTENCE OF σ-PHASES. Gudzenko, V. N.; Polesya, A. F. (Dnepropetrov State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 88-91(1974). (In Russian).

Regularities in the formation of structures during rapid crystallization of binary alloys containing σ phases were studied for the systems Co-V (31.8 to 85 at. % V), Mn-Cr (0.38 to 28 at. % Cr), Co-Cr (60 at. % Cr), and Ni-V (60 at. % V). At cooling rates of 10^7°/s of the melts there was suppression of the formation of the σ phase in all the alloy systems studied and crystallization of a metastable phase with bcc lattice. The concentration region for the existence of this phase in the Mn-Cr and Co-V systems is much wider than for the existence of σ phases. (JSR)

30248 RECOVERY OF THE MECHANICAL PROPERTIES, ELECTRIC RESISTANCE, AND MICRODEFORMATIONS OF DEFORMED BERYLLIUM. Papirov, I. I.; Volokita, G. I.; Kapcherin, A. S.; Stoev, P. I. (Physical-Technical Inst., Kazan). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 100-105(1974). (In Russian).

Data are reported from complex studies of the recovery of different characteristics of Be directed toward establishing relations among the athermal stress components, microdeformations, and dislocation density. The recovery of the properties of Be was studied using three methods: measurement of the electrical resistance, analysis of the width of the x-ray diffraction lines, and measurement of the yield point. Data are presented graphically for these measurements after annealing deformed Be at temperatures from 573 to 1023°K. The data obtained showed the absence of any relation between the x-ray microstresses and the level of stress determining the athermal component during mechanical testing. The recovery of the microstress is almost complete after 15 min annealing at 550°K, whereas the yield point of the deformed metal starts to be reduced at annealing temperatures above 600°K. (JSR)

30249 ABSENCE OF THE INFLUENCE OF PAULI SPIN PARAMAGNETISM ON H_{c2} FOR A Ti-11 AT. % Nb ALLOY. Missell, F. P.; Oliveira, N. F.; Shapira, Y. (Univ., Sao Paulo, Brazil). Phys. Status Solidi (b); 67: No. 1, K11-K13(1 Jan 1975).

The temperature dependence of the critical field (H_{c2}) for the superconducting alloy Ti-11 at. % Nb in the temperature range $1.68 \leq T \leq 5.40$°K ($= T_c$) was measured. Resistive transitions were observed by standard four-wire techniques in a superconducting solenoid with the magnetic field parallel to the current direction. The criterion for H_{c2} was chosen to be the zero voltage intercept of the linear portion of the transition on a voltage-versus-field curve for a current density of ≈ 1 A/cm^2. H_{c2} was found to be independent of current density below this value. (auth)

30250 ULTRASONIC DETERMINATION OF THE ENERGY GAP IN SUPERCONDUCTING LAYERS. Kraetzig, E.; Rosenkranz, M. (Philips Forschungslaboratorium, Hamburg). Phys. Status Solidi (b); 67: No. 1, K19-K21(1 Jan 1975).

Ultrasonic attenuation measurements of superconducting Pb, In, and Sn layers evaporated on quartz substrates at room temperature are reported. In these polycrystalline layers no amplitude dependent effects are found in agreement with theoretical conceptions. Results are presented in graphs showing ratios of ultrasonic attenuation, tunneling, and electromagnetic absorption. (JRD)

30251 SHOCK-WAVE COMPRESSION OF SINGLE-CRYSTAL BERYLLIUM. Pope, L. E.; Johnson, J. N. (Sandia Labs., Albuquerque, NM). J. Appl. Phys.; 46: No. 2, 720-729(Feb 1975).

Beryllium single crystals were shock loaded by planar impact along the a and c axes as well as along off-axis directions. The orientation of primary (basal), secondary (first-order prism), and tertiary (second-order pyramidal) slip systems, in addition to the relative magnitudes of their yield stresses, permits the study of dynamic yield behavior on each system separately. Slip on the primary system is activated by shock loading in directions which make angles $\theta = 23$ to 61° with respect to the c axis. The dynamic shear yield strength on the basal plane varies from 0.6 to 1.9 kbar depending on the shock-propagation direction: this effect is thought to be due to differences in compressive strain perpendicular to the basal plane. In all single crystals the rise times of the elastic waves are on the order of a few nanoseconds in contrast to the relatively long rise times reported for shock compression of polycrystalline beryllium. Dynamic yielding on secondary and tertiary planes results in significant stress relaxation behind the elastic wave front. This suggests that dislocations on these planes are undergoing rapid multiplication on a submicrosecond time scale. The method of characteristics for rate-dependent material response is used to study dislocation multiplication and plastic wave propagation in crystals shock loaded along the a axis. The phenomenon of multiple plastic wave propagation is also observed and compared with finite-difference solutions for plane shock-wave propagation in anisotropic media. The shock-wave behavior of single-crystal beryllium is more complicated than one would expect on the assumed basis of elastic-perfectly plastic response of the three known slip systems. (8 fig, 4 tables, 38 references) (auth)

30252 STUDY OF THE FATIGUE CRACK GROWTH IN LOW CARBON AUSTENITIC STAINLESS STEELS 304 L AND 316 L. Yahiaoui, B.; Petrequin, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). Rev. Phys. Appl.; 9: No. 4, 683-690 (Jul 1974). (In French).

From conference on applications of fracture mechanics; Cadarache, France (28 Nov 1973).

The fatigue crack growth at room temperature in low carbon austenitic stainless steels 304 L and 316 L, was studied. The main results are the following: fatigue crack growth rate obey the Paris law; under the same solicitations, fatigue crack growth rate is higher for 304 L steel than for 316 L steel. The influence of the mean stress (R ratio) is quite complex. The effect of the crack length seems to be higher than predicted by the Paris law. By comparison with the literature, the low carbon austenitic steels (304 L) studied present a higher crack growth than normal carbon austenitic steels (304). The values of the stress intensity factor variation, leading to a crack growth rate of 10^{-5} c/cycle at R = 0, are 23 MPa m for 304 L steel and 27-28 for 304 steels. On both materials studied, a threshold of nonpropagation after 2×10^6 cycles (Ks) was observed. This threshold is quite low (5 to 10 MPa m). It depends linearly of the R ratio and is higher for 316 L steel than for 304 L steel. The cracks are generally transcrystalline. However, intergranular cracking was observed in some few cases at very low crack growth rates near the arrest zones. (FR)

30253 BAND STRUCTURE OF CaCd AND CaTl AND THE KNIGHT SHIFT OF ^{113}Cd- AND ^{205}Tl-NMR IN THE SYSTEM $CaCd_{1-x}Tl_x$. Schmidt, P. C.; Weiss, A. (Technische Univ. Darmstadt (F. R. Germany). Physikalische Chemie 3). Z. Naturforsch., a; 29: No. 3, 477-487(Mar 1974).

The energy bands of ordered CaCd and CaTl were calculated by the nonrelativistic augmented plane wave (APW) method. The electron structure in the system $CaCd_{1-x}Tl_x$ is deduced from these calculations by using the rigid band model for the phases with $0 < x < 1$. The band structures of CaCd and CaTl are similar to the valence bands of other phases of the CsCl-type. From the energy eigenvalues the electronic density of state curve, the partial densities of state curves, and the Fermi energy were obtained. For states near the Fermi surface the spin density at the position of the Cd- and Tl-nuclei was determined. The Knight shift K_s of the ^{113}Cd-NMR and the ^{205}Tl-NMR in the system $CaCd_{1-x}Tl_x$ was calculated as a function of x. The slope of the curve K_{zz} for

the Cd–NMR is equal for experimental and theoretical results. The absolute value of the calculated Knight shift is about a factor of 1.4 too small. Only the direct term to the Knight shift was calculated. Relativistic effects were included by a scale factor. It was not possible to explain the shape of the function K_{α} for the Tl–NMR, since a full relativistic APW calculation is necessary for CaTl. (auth)

30254 RECRYSTALLIZATION OF TUNGSTEN FIBERS IN NICKEL MATRIX COMPOSITES. Hoffmann, J.; Hofmann, S.; Tillmann, L. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Werkstoffwissenschaften). Z. Metallk.; 65: No. 11, 721-726(Nov 1974). (In German).

The strength of nickel tungsten composites is weakened after an annealing treatment at 1,350°C. This is due to a recrystallization in the tungsten fibers. Examinations of the fracture surfaces with scanning electron microscopic and auger electron spectroscopic techniques show that a nickel-induced recrystallization takes place. The presence of about one monolayer of nickel atoms in the tungsten grain boundaries was detected. (auth)

30255 DIFFUSION IN THE TERNARY SYSTEM TITANIUM-VANADIUM-ZIRCONIUM AT 800°C. P. 1. Build-up of the Diffusion Zones. Brunsch, A.; Steeb, S. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Werkstoffwissenschaften). Z. Metallk.; 65: No. 11, 714-720(Nov 1974). (In German).

14 figs.; 3 tabs.; 25 refs. Part of a diss. by A. Brunsch.

An investigation was made of diffusion behavior in the ternary system titanium–vanadium–zirconium at 800°C. Measurements were done by means of an electron microprobe. A method for conversion of measured intensity ratios into weight concentrations is given. The structure of diffusion zones in 36 different ternary diffusion specimens is described and discussed by means of scanning pictures from the microprobe, by means of optical microscopy, intensity profiles, and concentration runs in the ternary system. An improved isothermal section at 800°C within the diagram titanium–vanadium–zirconium is given. The validity of the so-called Kirkaldy rules was confirmed. (auth)

30256 ELECTRONIC STRUCTURE OF LIQUID TRANSITION AND RARE-EARTH METALS AND THEIR ALLOYS. Busch, G.; Guentherodt, H. J.; Kuenzi, H. U.; Meier, H. A.; Schlapbach, L. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik); Keller, J. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Quimica). J. Phys. (Paris), Colloq.; No. 4, 329-336(1974).

From colloquium on disordered metallic systems; Strasbourg, France (10 Sep 1973).

The recent progress in the experimental work on liquid transition and rare earth metals and their alloys is reviewed. The results are compared with recent theories taking into account the 3d, 4f and 5d states, respectively. (auth)

30257 PHYSICAL STUDY OF THE RUPTURE OF URANIUM–0.2 WT % VANADIUM ALLOY. Poirier, J.; Dubois, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). Compt. Rend., Ser. C; 279: No. 8, 299-302(19 Aug 1974). (In French).

In a toughness sample of uranium alloyed with 0.2% vanadium by weight, a crack subjected to a mode I traction stress spreads intermittently. The extension process can be described by fractographic examination: intergranular decohesions at the head of the main crack, meeting afterwards, by ductile tearing of the bridges. (FR)

30258 FABRICATION OF Mg CANS FOR NUCLEAR POWER PLANT FUEL ELEMENTS. Portal, P.; Liefroid, S. (Forges de Bologne, 52 (France)). Mach. Outil Fr.; No. 313, 129, 131, 135, 137(Nov 1974). (In French).

The successive machining steps in the production of various fuel cans for nuclear power plants are described. They are produced on standard automatic milling machines, specially adapted to each of these operations. (FR)

30259 VACANCY DEFECTS IN QUENCHED CADMIUM. Simon, J. P. (CEN, Grenoble, France); Vostry, P.; Hillairet, J.; Levy, V. Phil. Mag.; 31: No. 1, 145-160(Jan 1975).

High-purity cadmium single crystals and polycrystalline strips have been quenched from temperatures ranging between 0 and 240°C to 4.2°K. The recovery of the quenched-in resistivity shows that the elimination of the supersaturated vacancies occurs between 130 and 180°K. Both formation and migration energies for single vacancies could be determined: $E^{F}_{1V} = 0.42 \pm 0.03$ eV, and $E^{M}_{1V} = 0.43 \pm 0.03$ eV, together with an evaluation of the characteristics of divacancies ($E_{2V} \simeq 0.15$ eV). A low density of large vacancy loops is present at room temperature in the quenched specimens. (auth)

30260 SPIRAL FLUXLINES IN IRREVERSIBLE SUPERCONDUCTING CYLINDERS. Timms, W. E.; Walmsley, D. G. (New Univ. of Ulster, Coleraine, Eng.). J. Phys., F (London); 5: No. 2, 287-306(Feb 1975).

The literature of type II superconductors subjected to parallel currents and fields is reviewed. Certain deficiencies in the pertinent theories are indicated and possible improvements suggested. From a general argument of magnetic reversibility, it is concluded that there must be torsional shear stresses in lattices which are in torsional strain. A possible source of the stresses is suggested. Since these stresses are difficult to calculate, a particular situation is considered in which the stresses are completely absent. This is a special case of what is called the constant pitch model of spirals in a cylinder. Two other models are introduced to give insight to the magnetic behavior when the pitch of the spirals increases or decreases as they move radially. Calculations are performed and compared with experiments on a cylinder of Pb–56 at. % Bi alloy to which an increasing field is applied at constant angle to the axis and in the surface plane of the sample. It is found that the constant pitch model gives best agreement with experiment. The most important shortcoming of the model is that, when the azimuthal applied field becomes large, the predicted axial moment is less than observed. This discrepancy is discussed and it is concluded that axial line tension forces and flux cutting, perhaps at normal inclusions, must be considered if the system is to be completely understood. (auth)

30261 ACOUSTIC SURFACE WAVE STUDY OF CRITICAL MAGNETIC FIELDS OF SUPERCONDUCTING Fe/Pb SANDWICHES. Bishop, G. N. (Univ. of Essex, Colchester, Eng.). J. Phys., F (London); 5: No. 2, 278-286(Feb 1975).

The temperature dependence of the parallel and perpendicular critical fields of superimposed Fe/Pb films is investigated using acoustic surface waves. A theoretical comparison is made using Ginzburg–Landau theory. Satisfactory agreement with experiment is found provided the coherence length in the lead is taken from measurements on an isolated lead film and the leakage length of Cooper pairs into the iron is expressed in terms of an electron relaxation time. Diffusion between the two metals is thought to be negligible. (auth)

30262 COMPILATION OF DISLOCATION TRACTIONS IN ANISOTROPIC CUBIC METALS. Bacon, D. J.; Scattergood, R. O. (Univ. of Liverpool). J. Phys., F (London); 5: No. 2, 193-204 (Feb 1975).

Calculations were made of the components, and their angular derivatives, of the stress produced in the slip plane of infinite straight dislocations in fcc and bcc metals. Results are presented in a compact manner by tabulating the coefficients of the Fourier series which fit the data to a high degree of accuracy. It is explained how the data can be used to incorporate elastic anisotropy into any two-dimensional dislocation problem in a straightforward way. The metals dealt with include Mo, Nb, Ni, Tb, and V. (auth)

30263 METALLOGRAPHY IN HOT CELLS. Pejsa, R.; Schreibmaier, J. pp 107-125 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (1974). (In German).

10 figs. Available from the Gesellschaft fuer Kernforschung.

A short survey is given on equipment, preparation technique and investigation methods of the metallography in hot cells in the nuclear research center, Karlsruhe. (auth)

30264 SUPERCONDUCTING PROPERTIES OF $LaOs_2$. Hoenig, H. E.; Baberschke, K.; Schrittenlacher, W. (Univ., Frankfurt am Main). Solid State Commun.; 16: No. 3, 341-344(1 Feb 1975).

For superconducting $LaOs_2$ of the pure C-15 phase, the low temperature specific heat, upper critical field, and susceptibility in the normal state were measured. From the specific heat results, the transition temperature of the C-15 phase is confirmed and several thermodynamic parameters of the normal and superconducting state like γ, θ_D, ΔC, $\Delta(0)$, and $H_c(0)$ are derived. Results suggest that $LaOs_2$ is an extremely strong coupling superconductor like La_3In and La_3Tl. (auth)

30265 RECRYSTALLIZATION AND CREEP OF TUNGSTEN WIRES IN NICKEL–TUNGSTEN COMPOSITES. Fischmeister, H. F.; Kannappan, A. (Chalmers Tekniska Hoegskola, Goteborg). High Temp.–High Pressures; 6: No. 3, 285-291(1974).

From 8th Plansee seminar; Reutte, Austria (27 May 1974).

A technique for producing nickel–tungsten composites by powder forging, which produces no detrimental interaction between the tungsten fibers and the matrix, is described. Long exposure to high temperatures provokes recrystallization of the tungsten–even when the latter is alloyed with rhenium or thoria–and loss of strength. At the same time, the creep strength of the wires is drastically reduced. The creep data are consistent with Coble creep enhanced by the presence of nickel at the tungsten grain boundaries. (auth)

30266 THERMO AND ELECTROTRANSPORT OF OXYGEN AND NITROGEN IN VANADIUM, NIOBIUM, AND TANTALUM. Kirchheim, R.; Fromm, E. (Max-Planck-Institut fuer Metallforschung, Stuttgart). High Temp.–High Pressures; 6: No. 3, 329-339(1974). (In German).

From 8th Plansee seminar; Reutte, Austria (27 May 1974).

Transport of oxygen and nitrogen atoms in vanadium, niobium, and tantalum induced by thermal gradients and by external electrical fields was investigated. It was found that the dissolved gas atoms migrated to the cathode in an electric field whereas in a temperature gradient, wherever this could be established, they migrated to the hotter regions of the sample. Results are expressed in terms of the usual parameters Q* (heat of transport) and Z* (effective charge); their dependence on temperature and concentration was determined for the Ta–O system. An interpretation of the transport phenomena is given on the basis of the electron drag model. Changes in interstitial concentration were estimated, which have to be expected in the metals on heating them with ac or dc current. First-order approximations are derived for the case of nitrogen and oxygen in tantalum. (auth)

30267 ELECTROTRANSPORT IN COPPER ALLOY FILMS AND THE DEFECT MECHANISM IN GRAIN BOUNDARY DIFFUSION. D'Heurle, F. M.; Gangulee, A. (IBM Watson Research Center, Yorktown Heights, NY). Thin Solid Films; 25: No. 2, 531-544(Feb 1975).

Among the polycrystalline thin film conductors of Al, Cu, Ag, Au and their alloys, conductors made of Cu alloyed with Be exhibit the longest lifetimes under similar conditions of electromigration testing. Data were analyzed for a Cu–Al sample tested at 2×10^6 A cm^{-2} and 265°C for 1400 h and for a Cu–Be sample tested at 3×10^6 A cm^{-2} and 291°C for 13,000 h. In both cases the transport of Cu occurred from the negative to the positive terminal. The rate of grain boundary diffusion of Cu in Cu–Be is more than fifteen times smaller than that in Cu–Al. Observations of mass transport effects due both to electromigration and to compressive stresses in Cu–Al samples indicate that the atomic flux in grain boundary diffusion is accompanied by a counter flux of defects, presumably vacancies. (auth)

30268 ELECTROMIGRATION IN THIN GOLD FILMS ON MOLYBDENUM SURFACES. Blech, I. A.; Kinsbron, E. (Technion–Israel Inst. of Tech., Haifa). Thin Solid Films; 25: No. 2, 327-334(Feb 1975).

Electric current was passed through thin gold films deposited onto molybdenum surfaces. The edge of the gold film closer to the cathode was seen to move towards the anode, leaving a free molybdenum surface. Large hillocks and crystallites were seen to accumulate on the gold edge pointing toward the anode. The velocity of the film edge was assumed to represent the average drift velocity for electromigration. The velocity of the gold edge was found to be constant at any given temperature and current density. At any constant temperature, the velocity was proportional to the current density. Finally, the velocity depended exponentially on the temperature. Current densities of 10^5–10^6 A cm^{-2} were used at temperatures of 260°–500°C. The "activation energy" for the drift velocity was found to be 0.6 eV in most samples, while some samples showed an energy of about 0.9 eV. The drift velocities per unit current density ranged between 10^{-13} and 10^{-15} cm^3 A^{-1} s^{-1} and the gold motion was always in the direction of electron flow. (auth)

30269 IMPLANTED NOBLE GAS ATOMS AS DIFFUSION MARKERS IN SILICIDE FORMATION. Chu, W. K. (California Inst. of Tech., Pasadena); Lau, S. S.; Mayer, J. W.; Mueller, H.; Tu, K. N. Thin Solid Films; 25: No. 2, 393-402(Feb 1975).

Implanted noble gas atoms of Ar and Xe were used as diffusion markers in growth studies of silicides formed by reacting metal films with silicon substrates. MeV ^4He ion backscattering was used to determine the displacement of the markers. Two approaches were used: either the silicon samples were implanted with Xe or Ar and then covered with a thin layer of metal, or the metal layer was implanted with the marker. When the sample was heated to form the silicide layer, the displacement of the marker relative to the surface determined the identity of the diffusing species. Diffusion markers were used in growth studies of six silicides: Ni_2Si, Mg_2Si, FeSi, VSi_2, $TiSi_2$ and Pd_2Si. Si atoms are the predominant moving species in diffusion in VSi_2, $TiSi_2$ and FeSi, while Ni atoms are the moving species in Ni_2Si and Mg in Mg_2Si. In Pd_2Si, both Pd and Si are diffusing species with Si the faster of the two. Chemical effects can play a role in marker studies. In the thermal oxidation of Si, the displacement of Xe markers is consistent with the fact that oxygen is the moving species. Implanted As, on the other hand, accumulates at the $Si–SiO_2$ interface. Therefore, it is necessary to choose markers which are chemically inert. (auth)

30270 REPORTS OF CURRENT WORK ON BEHAVIOR OF MATERIALS AT ELEVATED TEMPERATURES. 1974 ASME Winter Annual Meeting, New York, November 18–21, 1974. Schaefer, A. O. (ed.). New York; American Society of Mechanical Engineers (1974). 189p. (CONF-741142-). $18.00.

Five papers are presented on some characteristics of metals and alloys at elevated temperatures: low-cycle fatigue and creep interactions in steels, compression relaxation in two Al alloys, stress relaxation in Al alloys in tension, size effect in creep and rupture tests on unnotched and notched Cr–Mo–V steel, and application of elevated-temperature yield strength in design. Separate abstracts were prepared for two of the papers. (DLC)

For abstracts of individual papers see: 30271 and 30272.

30271 STUDY OF LOW-CYCLE FATIGUE AND CREEP INTERACTIONS IN STEELS AT ELEVATED TEMPERATURES. Curran, R. M. (General Electric Co., Schenectady, NY); Wundt, B. M. pp 1-104 of Reports of Current Work on Behavior of Materials at Elevated Temperatures. Schaefer, A. O. (ed.). New York; American Society of Mechanical Engineers (1974).

From meeting on current work on behavior of materials at elevated temperatures; New York, New York, USA (18 Nov 1974). See CONF-741142-.

Interspersion testing appears to be an economical method of characterizing material behavior under circumstances where low-cycle fatigue damage and creep-rupture damage are imposed simultaneously. The behavior of the five materials tested in this program differed greatly in their response to the combined damage cycles imposed, with the austenitic Type 304 steel showing a substantial degradation and annealed 2¼ Cr–1 Mo steel essentially showing no effect with respect to a simple life fraction representation. The behavior of the heat treated Cr–Mo–V steel and 2¼ Cr–1 Mo steel was intermediate between these extremes. There is evidence that in the heat treatable steels and in the austenitic material that metallurgical changes are accelerated as a result of the imposed strain cycles that have been interspersed between the constant stress creep-rupture exposures. It is suggested that accelerated under these test conditions may be the degradation mechanism. (19 tables, 100 figures) (auth)

30272 SIZE EFFECT IN CREEP AND RUPTURE TESTS ON UNNOTCHED AND NOTCHED SPECIMENS OF Cr–Mo–V STEEL. Schmieder, A. K. (General Electric Co., Schenectady, NY). pp 125-155 of Reports of Current Work on Behavior of Materials at Elevated Temperatures. Schaefer, A. O. (ed.). New York; American Society of Mechanical Engineers (1974).

From meeting on current work on behavior of materials at elevated temperatures; New York, New York, USA (18 Nov 1974). See CONF-741142-.

This material was tested in two conditions of heat treatment chosen to give one material not sensitive to notches and a second which is notch weakened. Tests were made on four sizes of specimens ranging from 1/36 to 6 square inches in root area. Each specimen configuration was tested at 1000°F at three stress levels to give lives ranging from 1000 to 10,000 hours. One series of specimens had a constant notch root radius. A second series had geometrically similar notches for all sizes. Results show a consistent and significant reduction of time to rupture with increasing size for the notched specimens and a more complex response for the unnotched specimens. (auth)

30273 EFFECT OF RAPID HEATING AND COOLING ON THE TRANSITION FROM TRANSCRYSTALLINE TO INTERCRYSTALLINE FRACTURE OF LOW-ALLOY Mo ALLOYS. Drachinskii, A. S.; Pisarenko, V. A.; Trefilov, V. I. (Inst. of Physics of Metals, Kiev). Strength Mater. (USSR) (Engl. Transl.); 6: No. 4, 452-454(Apr 1974).

Translated from Probl. Prochnosti; 6: No. 4, 54-56(Apr 1974).

The dependence of breaking stress on grain size was determined for three low-alloy Mo alloys after various heat treatments. A sharp reduction of the breaking stress observed for coarse grain samples was due to a transition from intracrystalline to intercrystalline fracture. One of the causes of the changing percentage of intercrystalline fracture in all rapidly heated and cooled alloys was the delay in the development of collective recrystallization. (PMA)

30274 ORIENTATION CHARACTERISTICS OF SLIP IN THE CREEP OF Mo SINGLE CRYSTALS IN THE TEMPERATURE RANGE 800 to 1800°C. Zasimchuk, E. E.; Krivenyuk, V. V.; Marusii, O. I. (Inst. of Problems of Strength, Kiev). Strength Mater. (USSR) (Engl. Transl.); 6: No. 4, 455-460(Apr 1974).

Translated from Probl. Prochnosti; 6: No. 4, 57-62(Apr 1974).

The deformation under creep conditions was measured for flat Mo single crystals produced by electron beam melting. For creep

in specimens extended in the (110) and (112) directions in the temperature range 800–1800°C, slip occurs mainly on planes of the system (312). The {110} slip system is secondary, being found only in prolonged tests. (PMA)

30275 INVESTIGATIONS OF HIGH STRENGTH AND WEAR RESISTANT STEELS OF THE G13L TYPE. Kornaushenkov, N. G.; Astaf'ev, A. A.; Kornaushenkova, Yu. N. Strength Mater. (USSR) (Engl. Transl.); 6: No. 4, 497-499(Apr 1974).

Translated from Probl. Prochnosti; 6: No. 4, 98-99(Apr 1974).

The effects of complex alloying of Mo, Cr, W, and Ti on the mechanical properties and wear resistance of G13L type steels were studied, and may be explained by the different structural states, austenite stability, and cold working capacity. Metallographic analysis showed that G13L steel has an austenitic structure, but the grain boundaries are diffuse and isolated carbides are overlooked. The G13Kh1M1TL and G13Kh1MTL steels have a homogenous austenitic structure with well defined boundaries without carbides. Mo, Cr, and Ti considerably increase the stability of the austenite during both heating and cooling. After quenching, the hardness and rate of hardening are greater for the G13Kh1M1TL and G13Kh1MTL steels than the G13L steel. (PMA)

30276 OROWAN MECHANISM IN ANISOTROPIC CRYSTALS. Scattergood, R. O.; Bacon, D. J. (Univ. of Liverpool). Phil. Mag.; 31: No. 1, 179-198(Jan 1975).

The static equilibrium configurations of a dislocation bypassing a periodic row of impenetrable circular obstacles were obtained for various crystals by means of a self-stress method wherein the elastic anisotropy of the crystal and the dislocation self-interaction could be taken into account. A correlation was developed from the results which related the Orowan stress values to the obstacle size and spacing. This correlation demands two parameters to account for the anisotropy, and these appear as a suitably defined anisotropic shear modulus and Poisson's ratio. The self-interactions are taken into account by a single logarithmic parameter which is the harmonic mean of the obstacle size and spacing, and is independent of anisotropy. The shapes of the bowing dislocation loops are strongly influenced by the anisotropy and interactions. The combined effects on shape can be simply described in the line-tension framework, using the de Wit-Koehler solutions. In particular, the swept areas and overall profiles of the shapes obtained in this investigation can be matched over a wide range of conditions by de Wit-Koehler shapes using a line tension proportional to the logarithm of the obstacle spacing. (auth)

30277 STACKING FAULT ENERGIES OF Be, Mg, Al, Cu, Ag, AND Au. Devlin, J. F. (Battelle Columbus Labs., OH). J. Phys., F (London); 4: No. 11, 1865-1882(Nov 1974).

Expressions are derived for the stacking fault energies of close packed metals. The technique employs periodic boundary conditions on a crystal containing a large number of widely spaced faults. All necessary summations are performed in wavenumber space. Reasonable agreement is obtained with experiment for the metals Be, Mg, Al, Cu, Ag, and Au. Contrary to some earlier work it is found that the electrostatic contribution to the fault energy can be quite significant. The noble metal calculations include an evaluation of the d state overlap energy term; and this is shown to be small in comparison to the other contributions. (auth)

30278 EFFECT OF Ni ON THE TENSILE AND IMPACT PROPERTIES OF Mn–Mo STEEL FOR PRESSURE VESSEL. Enami, T.; Hatomura, T.; Tanaka, T.; Funakoshi, T. (Kawasaki Steel Corp., Chiba (Japan). Technical Research Lab.). Kawasaki Seitetsu Giho; 6: No. 2, 162-173(Apr 1974). (In Japanese).

Effect of Ni on the tensile and impact properties of Mn–Mo steel was studied under quenching and tempering conditions corresponding to heavy section plate. In moderate quenching rate, Ni increased the yield and tensile strength, lowered the 50% fracture appearance transition temperature. On the other hand, in slow quenching rate, Ni had additional strengthening effect, but no effect on the 50% fracture appearance transition temperature. These effects of addition of Ni were not influenced by tempering conditions in both quenching rates. These results can be explained mainly by the solid solution effect to the ferrite and partially by the difference of quenched structure due to Ni. (auth)

30279 THERMODYNAMICS OF FORMATION AND MELTING BEHAVIOR OF RARE EARTH-PALLADIUM COMPOUNDS ($RE_{33}Pd_{23}$). Palenzona, A.; Cirafici, S. (Univ., Genoa). Thermochim. Acta; 10: No. 3, 313-317(Nov 1974).

Using the dynamic differential calorimetric method (DDC), heats of formation, heats and entropies of fusion were measured for $RE_{33}Pd_{23}$ compounds where RE = Tb, Dy, Ho, Er, Tm, and Lu. The apparent anomalous change in the thermodynamic properties of these phases is confirmed by similar changes in other physical and mechanical properties such as density and microhardness. In this case the thermodynamic data, beyond their essential meaning, make it possible to evidence crystallographic details not yet known. (NL)

Radiation Effects

Refer also to abstracts 29314, 29391, 31825, 31826, 31989, and 32232.

30280 (CEA-CONF-2873) RADIATION EFFECTS ON SOLID STATE DIFFUSION. Adda, Y.; Beyeler, M.; Brebec, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Section de Recherches de Metallurgie Physique). 1974. 74p. (CONF-740827-3). Dep. NTIS (US Sales Only) $6.75.

From international conference on low temperature diffusion; Yorktown Heights, New York, USA (12 Aug 1974).

Methods are presented for describing the evolution of irradiation defects as a function of temperature, defect rate production, sink density, and other parameters. Equations for calculating diffusion coefficients under irradiation are discussed. A critical study of the literature data and of the existing models points out theoretical problems which, up to now, have limited the rigorous analysis of diffusion under irradiation. Also emphasized are the difficulties of performing experiments which can be interpreted unambiguously. (auth)

30281 (CONF-750335-11) USE OF ACCELERATORS TO STUDY IRRADIATION EFFECTS IN MATERIALS. McHargue, C. J. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 15p. Dep. NTIS $4.00.

There is currently high interest in the use of accelerators to study irradiation effects in materials to be used in reactors. The effects produced by heavy ion irradiation (e.g., nickel ions irradiating stainless steel) and fast neutron irradiation are qualitatively similar. Time to achieve the damage state characteristic of end-of-life service is hours as opposed to several years in available reactors. Some of the successes in this area are described, as well as some of the many problems to be solved in order to establish quantitative relationships. (auth)

30282 (FZK-263-1) NERVA MATERIALS IRRADIATION PROGRAM. Volume I. GTR Test 16, AGC Materials Test. Thornton, H. G. (General Dynamics/Fort Worth, Tex. (USA)). 20 Oct 1965. 392p. Dep. NTIS $22.75.

The test was designed to determine the combined effects of nuclear radiation and liquid–hydrogen temperatures on the tensile and shear properties of Al (A356, 6061, and 7075 in T-6), stainless steels (347, 440C, A-286, D-979, 410), Ni alloys (Inconels X-750 and 713 C, Hastelloy C), and A-110-AT titanium. Specimens of the materials were mounted in AGC cryogenic materials pulling assemblies, submerged in liquid hydrogen, and irradiated for close to 200 h. While still in liquid hydrogen, the specimens were pulled in tension or shear until fracture occurred. After the radioactivity had decayed sufficiently, the specimens were removed and measured for elongation and reduction in cross section. Selected specimens were then subjected to x-ray diffraction and metallographic studies. Two irradiations were both terminated before the scheduled 200 h because of suspected hydrogen leaks. The exposed neutron monitoring foils indicate that a typical neutron flux above 1.0 MeV was 2.44×10^4 n/cm^2-s-watt, or 5×10^{16} n/cm^2 integrated flux. Integrated fast- and thermal-neutron flux profiles giving the exposure at various specimen positions are given. From statistical analysis of stress-strain data, a radiation-effect threshold was found. Definite trends of decreased elongation and increased yield strength were noted. Some variation in ultimate tensile strength and shear strength was also noted. No significant change was encountered in the analysis of the notched-tensile-specimen data. (DLC)

30283 (FZK-263-2) NERVA MATERIALS IRRADIATION PROGRAM. Volume II. GTR Test 16-WANL Materials Test. Palmer, E. E.; McMillan, W. D. (General Dynamics/Fort Worth, Tex. (USA)). 29 Oct 1965. 191p. Dep. NTIS $12.75.

Three tests were performed: metal and graphite tensile specimens, steel-wire resistivity specimens, and stainless-steel spring specimens at LN_2 and elevated temperatures; O-ring seal test fixtures in a gaseous-hydrogen environment; and unfueled fuel-element segments containing cemented orifices at LN_2 and ambient-air temperatures. The irradiation tensile specimens were irradiated at LN_2 temperatures to a maximum integrated neutron flux of 1.0×10^{19} n/cm^2 (E > 1 MeV). After storage in LN_2 for 30 days, the specimens were tested in tension to break under various test conditions ranging from a –320°F test temperature without an annealing treatment to a 1290°F test temperature after a 1-h annealing treatment at some elevated temperature. All specimens were maintained at LN_2 temperatures without warmup from before the irradiation until the annealing cycles were begun (about 60

days). Those specimens that were not annealed were maintained in LN_2 without warmup until after they were pulled in tension to break. Significant changes in the tensile properties were noted in all materials maintained in LN_2 without warmup, with appreciable to complete recovery after annealing. Changes in ultimate tensile strength were generally slight except for a decrease of 70% in Be maintained at LN_2 temperature. Changes in tensile yield strength were generally significant, with increases of from 7 to 47% experienced by all materials maintained in LN_2 except Be, which showed a decrease of 70%. Changes in notched tensile strength were generally slight to significant, with increases of from 2 to 22% experienced by all materials maintained in LN_2 except Ti and Be, which showed decreases of 7 and 9%, respectively. Significant decreases in ductility were evident in all specimens maintained in LN_2 except Be, which had no measurable elongation for either the control or the irradiated specimens. The four Inconel wire resistivity specimens were irradiated at LN_2 temperature to 4.5×10^{17} n/cm^2 (E > 1 MeV). After storage of three months at LN_2 temperature, the resistance as a function of annealing temperature and time was measured. During irradiation, resistance measurements of the Inconel 718 specimen indicated an increase of approximately 0.02 ohm. Postirradiation resistance measurements after annealing indicated a maximum resistance increase of approximately 0.013 ohm. Four of the eight stainless-steel springs were irradiated at LN_2 temperature to 4.5×10^{17} n/cm^2 (E > 1 MeV), with the other four as controls. Several postirradiation measurements, including spring constant, were made; radiation-induced changes were insignificant. (DLC)

30284 (FZK-342-2) NERVA MATERIALS IRRADIATION PROGRAM. GTR Test 19. Volume II. Comprehensive Presentation of Material Property Data. Smith, E. T. (General Dynamics/Fort Worth, Tex. (USA)). 1 Apr 1968. 641p. Dep. NTIS $35.25.

Data on properties of Nerva reactor materials are presented. Information is included on Al-base alloys, Ti-base alloys, A-286 alloy, Inconel alloys, Hastelloys, Udimet alloys, Waspaloy, and Be. (JRD)

30285 (KFK-1996) LOW TEMPERATURE IRRADIATION MEASUREMENTS OF A V_3Ga MULTIFILAMENTARY COMPOSITE WIRE. Krebs, K. R.; Maier, P.; Seibt, E. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). Dec 1974. 56p. (In German). Dep. NTIS (US Sales Only) $6.00.

Measurements were made on a V_3Ga multifilamentary composite wire (360 filaments) at the helium bath-irradiation facility of the Karlsruhe cyclotron for the determination of the angular dependent critical current and the volume pinning forces. The critical current, I_{co}, increased at a position parallel to the external magnet field ($\theta = 0°$) relative to a transversal position ($\theta = 90°$). An anisotropy was found for $I_{co}(0°)/I_{co}(90°) = 1.45 \pm 0.05$ between B = 3 and 7 T. The V_3Ga wire, kept at less than 15°K, was irradiated with 50 MeV deuterons up to a total maximum flux of 2.6×10^{17} cm^{-2}. A reduction of about 16% was observed in the transition temperature and the critical current decreased by ~50%. In subsequent annealing experiments conducted at room temperature (21°C) and at 100°C, only a small recovery, about 15% at the maximum, was obtained for the critical current. Some estimations are reported of the number of atomic displacements and defect cluster widths in sample material. Finally, the field dependence of the volume pinning force before and after irradiation is compared to theoretical models. (tr-auth)

30286 (TID/SNA-661) NERVA RADIATION EFFECTS SUMMARY REPORT. Carlson, E.; French, W. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 177p. Dep. NTIS $12.00.

A summary is given of: (1) materials, instrumentation, and components which have been tested from 1962 to 1968, and (2) radiation-effects information gained from testing of experimental reactors NRX-A2 through -A6. The materials included aluminum materials, high-strength and high-nickel materials, Ti alloys, stainless steel-347, A-286, Be, and bearing-gage materials. Components tested included thermocouples, resistance thermometers, pressure transducers, strain gages, accelerometers. The data are presented in extensive tables. (DLC)

30287 (TID/SNA-663) HIGH-TEMPERATURE RADIATION EFFECTS ON RENE 41, WASPALOY, AND INCONEL 718. Final Report, GTR-21, Test 37R017. French, W. E.; Brown, D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 25p. Dep. NTIS $4.25.

In Rene 41, Waspaloy, and Inconel 718 forgings, the tensile property most sensitive to radiation was elongation, which exhibited moderate to large decreases for nearly all test conditions. The damage threshold for elongation decrease at 1660°R and above is below 10^{16} n/cm^2 < 0.48 eV for all materials. The 0.2% offset yield strengths did not show a significant change. Irradiation did not affect the stress-strain curves except to interrupt them at a lower strain due to fracturing, thus lowering the elongation. For those test conditions in which the work hardening was not complete, premature fracture reduced the ultimate strength. Reduction of area and engineering fracture stress were usually changed due to premature fracture. Elongation damage appears to react its maximum at the higher fluences. The two alloys tested in stress rupture (Waspaloy and Inconel 718) showed significant reductions in time-to-failure, elongation, and reduction of area. Inconel 718 showed severe notch sensitivity in stress rupture. At 1760°R all irradiated notched specimens failed in the notched area; mean time to failure after 1.59 n/cm^2 < 0.48 eV exposure was 1.4 hours. (auth)

30288 (TID/SNA-1055) CRYOGENIC RADIATION EFFECTS ON NERVA STRUCTURAL MATERIALS. Lombardo, J. J.; Dixon, C. E.; Begley, J. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1965. 52p. Dep. NTIS $5.75.

NERVA engine environment and material property requirements are discussed. Cryogenic radiation tests performed on structural alloys in support of the NERVA Program are presented. Eleven alloys were irradiated in liquid hydrogen to an average dose of 5×10^{16} nvt (E > 1.0 MeV). These alloys, which were tested in tensile and shear in the post-irradiation condition prior to warm-up, include the aluminum alloys, A356-T6, 6061-T6 and 7075-T6; stainless steels, 347 and A-286; nickel-base alloys, Hastelloy C, Inconel X-750, and Inconel 713-C; and titanium alloy, Ti-5Al-2.5 Sn ELI. The nickel-base alloy D979 and stainless steel 410 were tested in shear only. Most alloys showed small but significant changes in one or more properties with the two cast alloys Inconel 713C and A356 being most affected. Notched tensile strengths were relatively insensitive to this dose level. Three alloys decreased in shear strength. Although aluminum alloys are quite insensitive to radiation damage at ambient and higher temperatures, their sensitivity to damage at cryogenic temperatures is comparable to the other alloys. Six alloys were irradiated in liquid nitrogen to neutron doses between 5×10^{17} and 1×10^{18} nvt (E > 1.0 MeV). These alloys were tensile tested without warm-up in the post-irradiation condition at 140°R. In addition, all alloys were annealed at room temperature for several days and later tested at 140 and 540°R. Selected alloys were annealed and tested at various temperatures up to 1750°R. The alloys tested in tension include the aluminum alloy 2219-T6; stainless steels, 301 cold worked and 303 Se annealed bar; the nickel base alloys, Inconel 718 and Inconel X-750; and titanium alloy Ti-5Al-2.5 Sn ELI. Radiation effects were noted in all materials on testing without warm-up. Partial or complete recovery of properties occurred at 540°R for all specimens. Marked differences were observed in the behavior of sheet and bar stock in Al 2219-T6 and Inconel 718. The influence of test temperature and test atmosphere are discussed, and recommendations are made for future radiation testing variables to obtain engineering design data. (auth)

30289 RADIATION EFFECTS ON SOLID STATE DIFFUSION. Adda, Y.; Beyeler, M.; Brebec, G. (CEN de Saclay, Gif-sur-Yvette, France). Thin Solid Films; 25: No. 1, 107-156(Jan 1975).

Methods are presented for describing the evolution of irradiation defects as a function of temperature, defect rate production, sink density etc. and the equations which allow the diffusion coefficient under irradiation to be calculated are discussed. A critical study of the literature data and of the existing models allows pointing out theoretical problems which, up to now, have limited the rigorous analysis of diffusion under irradiation. The difficulties of performing experiments which can be interpreted unambiguously are also emphasized. (auth)

30290 EFFECTS OF PROTON BOMBARDMENT ON SELF-DIFFUSION IN SILVER: A PRELIMINARY REPORT. Lam, N. Q.; Rothman, S. J.; Merkle, K. L.; Nowicki, L. J.; Dever, D. J. (Argonne National Lab., IL). Thin Solid Films; 25: No. 1, 157-166(Jan 1975).

The radiation-enhanced self-diffusion coefficient D_{rad} in silver under 270 keV proton bombardment was measured over the temperature range from 240° to −60°C. The flux dependence of D_{rad} was also studied at 106° and 179°C with the flux varying from 2.5×10^{12} to 6.3×10^{13} protons/cm^2 sec. The experimental data are analyzed in the framework of the classical model involving single vacancies and interstitials as mobile defects. (auth)

30291 INTERSTITIALCY DIFFUSION IN ELECTRON-IRRADIATED Cu-Ni ALLOYS. Poerschke, R.; Wollenberger, H. (Kernforschungsanlage, Juelich, Ger.). Thin Solid Films; 25: No. 1, 167-170(Jan 1975).

The well-known Ni cluster formation in solid solutions of Cu-Ni around the 50:50 composition was formerly observed during thermal annealing down to temperatures of about 620 K, when the vacancy mobility practically vanishes. In the work

presented, Ni cluster formation was observed during electron irradiation at temperatures as low as 100 K. The required mass transport must be due to an interstitialcy mechanism. The activation energy of interstitial motion is of the order of 0.2 eV. From the observed cluster formation, kinetic details of the interaction of migrating interstitials with other lattice defects can be derived. (auth)

30292 COMPUTER SIMULATION OF RADIATION DAMAGE IN AN ORDERED ALLOY. Schade, G. W.; Edwards, D. R.; Leighly, H. P. (Univ. of Missouri, Rolla). pp 413-415 of Proceedings of the 1973 Summer Computer Simulation Conference, La Jolla, California. La Jolla, CA; Simulation Councils Inc. (1973).

From Proceedings of the 1973 summer computer simulation conference; La Jolla, CA (1973).

A computer program was used to simulate the effects of irradiation on the order-disorder alloy Fe_3Al. The primary purposes of this study were three-fold: (1) to test and demonstrate the degree of correspondence to reality that can be realized from this model; (2) to incorporate advances in computer machinery and software into the model; and (3) to use the model to determine the response of Fe_3Al to irradiation. The crystal properties examined were: (1) the variance of damage energy threshold with crystal direction; (2) the predominate mechanism(s) responsible for damage; and (3) the means and rates of energy dissipation from the damage zones. A series of approximately 60 runs for 13 crystal directions and static tests were made. The damage energy thresholds varied from a low of 18.5 ev for the [100] direction to 82 ev in the [123] direction. In all cases the damaged condition consisted of vacancy-interstitial pairs. The number of pairs produced as well as the separation of the vacancies and interstitials depended on both energy and crystal direction. The paths of energy dissipation from the interaction zones were primarily [111] and [100] atom chains, with the relative importance of each type of chain depending again upon the initial energy and crystal direction. (auth)

30293 STUDY OF POINT DEFECTS IN ZIRCONIUM IRRADIATED BY NEUTRONS AT 24K. Vialaret, P.; Moreau, F.; Bessis, A.; Dimitrov, C.; Dimitrov, O. (Centre National de la Recherche Scientifique, 94 – Vitry-sur-Seine (France). Centre d'Etudes de Chimie Metallurgique). J. Nucl. Mater.; 55: No. 1, 83-95(Jan 1975). (In French).

The creation and annealing out of defects in pure zirconium irradiated at 24 K by fast neutrons were followed by measurements of electrical resistivity. The influence on these phenomena of metallic impurities and also of an interstitial metalloid solute was also determined, by examining two varieties of high-purity metal and some specially prepared zirconium–oxygen alloys (150-600 at. ppm). Using the rise of resistivity due to irradiation as a measure of the rate of damage, an apparent recombination volume of 195 ± 17 atomic volumes was found, independent of oxygen content. The isochronal recovery spectrum below 345 K incorporates five principal stages, for which interpretations are proposed. Additions of oxygen or of metallic solutes only marginally affect the various annealing stages. (auth)

30294 THE INFLUENCE OF Mg IN γ-IRRADIATION INDUCED CHANGES IN Al ALLOYS. Miura, K.; Fiore, N. F.; Allen, C. W. (Notre Dame Univ., Ind. (USA)). J. Nucl. Mater.; 55: No. 1, 53-63(Jan 1975).

Transmission electron microscopy studies of γ-irradiated Al and Al alloys indicate that precipitates may be dissolved and reprecipitated during irradiation of alloys containing Mg. During normal elevated temperature aging, Mg is know to accelerate nucleation and growth of precipitates. It therefore may act cooperatively with point defects created during γ-irradiation to bring about microstructural change. These changes are suppressed by severe cold work, perhaps because large dislocation densities may serve as sinks for radiation-induced point defects or perhaps because dislocation strain fields retard nucleation. The presence of Mg may be necessary for morphology changes to occur because Mg is susceptible to the ionization as well as the direct collision mechanisms of radiation change. (auth)

30295 RESIDUAL STRESS MEASUREMENTS IN IRRADIATED STAINLESS STEEL TUBING. Foster, J. P. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.); Bates, J. F. (Westinghouse Hanford Co., Richland, Wash. (USA)). J. Nucl. Mater.; 55: No. 1, 119-122(Jan 1975).

Irradiation-induced creep and swelling of structural materials are currently under intensive investigation in order to assess the design and performance of fast reactor core components. Results of residual stress measurements on mill-annealed Type 304 and 316 stainless steel tubing are reported. Mixed oxide fuel pins were irradiated in EBR-II with mill-annealed Type 304 and 316 stainless steel cladding. Fuel pins considered to have minimal fuel-cladding mechanical interaction were selected from test assemblies PNL-3, 5 and 8 for residual stress measurements. (auth)

30296 THE EFFECT OF IRRADIATION ON THE CORROSION RESISTANCE OF ORDERED Zr_3Al-BASED ALLOYS IN HIGH-TEMPERATURE WATER. Murphy, E. V. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). J. Nucl. Mater.; 55: No. 1, 117-118(Jan 1975).

The materials examined were Zr–2.5% Nb, Zircaloy-4, Zr–7.6% Al, Zr–8.6% Al and Zr–9.0% Al. The Zr–Al alloys were obtained as ~ 50.0 kg cast ingots. Corrosion coupons were cut from these ingots by abrasive machining. The Zr–Al corrosion coupons were fully transformed to a basically Zr_3Al matrix by heat-treating in an argon atmosphere for 0.172 Ms (48 h) at 875°C. Before corrosion testing, these coupons and the Zr–2.5% Nb coupons were polished to a 600 grit finish with SiC paper. The Zircaloy-4 coupons were pickled prior to the exposure. The water temperature was 220°C in the out-of-flux site and 223°C in the in-flux site. The average value of the fast flux was 5.0×10^{13} n cm^{-2} sec^{-1} (> 1.0 MeV) and the duration of the experiment was two reactor cycles, which was 6.811 Ms (1892 h). The results obtained on Zr–2.5% Nb and Zircaloy-4 are as expected in that irradiation in the absence of oxygen has no effect on Zircaloy-4 but irradiation can improve the corrosion resistance of Zr–2.5% Nb and of the Zr-Al alloys. (auth)

30297 CORDUROY CONTRAST OBSERVATIONS IN NEUTRON-IRRADIATED ZIRCONIUM AND ZIRCALOY. Bell, W. L. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Nuclear Center). J. Nucl. Mater.; 55: No. 1, 14-22(Jan 1975).

Observations of a particular as-irradiated microstructure are reported for Zircaloy and zirconium after neutron fluences of 2 to 25×10^{20} n/cm^2 at temperatures of 523 to 608 K. Because of the ribbed appearance of the electron microscope images, the term "corduroy" is used to describe the general microstructures encountered. Corduroy is a bulk microstructural feature (of irradiated crystals) with well-defined crystallographic properties. The rows of the corduroy are aligned parallel to traces of basal planes and the structure of corduroy is associated with a displacement vector of the type $\frac{1}{3}\langle 11\bar{2}0\rangle$, where $n \neq 0$. Corduroy is analyzed as being composed of small crystal regions misoriented from each other by small amounts so as to periodically vary the Bragg position of the diffracting planes between two extremes. Corduroy does not represent alignment of the common radiation damage clusters, but may be superposed upon these. Annealing experiments have eliminated the corduroy structure while causing the damage clusters to grow into resolvable loops. Corduroy does not appear to be strongly affected by fluence between 2 and 25×10^{20} n/cm^2 but is sensitive to irradiation temperature. (auth)

30298 COALESCENCE PHENOMENA: ISOTHERMAL ANNEALING OF DENSE VOID POPULATIONS IN METALS. Monty, C. (Centre National de la Recherche Scientifique, 92–Meudon-Bellevue (France). Lab. de Physique des Materiaux). pp 95-119 of The Precipitation Phenomena and Their Consequences on the Properties of Certain Industrial Alloy Systems. 16th Colloquium on Metallurgy. June 1973. Saclay, France; Institut National des Sciences et Techniques Nucleaires ([nd]). (In French).

From 16th colloquium on metallurgy. The precipitation phenomena and their consequences on the properties of certain industrial alloy systems; Saclay, France (25 Jun 1973).

Following a general review of inter-precipitate coalescence phenomena in metals, the special case of voids is described and the results are given concerning a study in which this pehnomenon was observed in a case hitherto unknown: the isothermal annealing of dense void populations produced by irradiation in metals. The method consisted of an electron microscopic examination of the effect of annealings on irradiation-induced voids in aluminium ribbons. Coalescence phenomena were revealed by comparing the experimental size distribution development with that predictable by calculation. (FR)

30299 PRECIPITATION UNDER IRRADIATION. Hudson, J. A.; Nelson, R. S. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). pp 65-93 of The Precipitation Phenomena and Their Consequences on the Properties of Certain Industrial Alloy Systems. 16th Colloquium on Metallurgy. June 1973. Saclay, France; Institut National des Sciences et Techniques Nucleaires ([nd]).

From 16th colloquium on metallurgy. The precipitation phenomena and their consequences on the properties of certain industrial alloy systems; Saclay, France (25 Jun 1973).

Some of the ideas developed to explain the results of experiments on the irradiation of alloys are reviewed. The theory is expanded to cover the case of irradiation of ordered precipitates such as γ'

and recent experimental results of ion and neutron bombarded Ni–Al alloys containing γ' are presented. Recent results of carbide precipitation in stainless steels and UAl_2 precipitation in α uranium are described. All the recent work involves the direct observation of precipitates in thin foils by bright and dark field electron microscopy. (FR)

30300 DAMAGE RECOVERY IN VANADIUM BETWEEN 3.8 TO 6.0 K. Coltman, R. R. Jr.; Klabunde, C. E. Jr.; Redman, J. K.; Williams, J. M. (Oak Ridge National Lab., TN). Radiat. Eff.; 24: No. 1, 69-70(1975).

The isochronal recovery of thermal neutron damage in V was recently studied (Klabunde et al., Phys. Stat. Sol.; (a)21: 303 (1974)) from 6 to 320°K by means of resistivity changes. One interesting result was the observation of continuous recovery from 6 to 40°K in contrast to the spectra of discrete recovery processes seen at low temperatures for thermal neutron damage in nearly all other metals studied. In this report results are given of an investigation which extends the recovery study of thermal neutron damage in V to 3.8°K. (auth)

30301 MEASUREMENT OF INTERNAL FRICTION AND SHEAR MODULUS OF ALUMINIUM–MAGNESIUM ALLOY AFTER NEUTRON IRRADIATION AT 78 K. Chountas, K.; Papathanassopoulos, K.; Andronikos, P.; Kontoleon, N. (Democritus Nuclear Research Center, Athens). Radiat. Eff.; 24: No. 1, 13-18(1975).

The internal friction and shear modulus of polycrystalline Al–3 at. % Mg was studied as a function of temperature after fast neutron irradiation, at liquid nitrogen temperature (78°K). The initial increase of shear modulus after irradiation is mainly due to the dislocation pinning of the irradiation-induced defects. The further increase of shear modulus during annealing is caused by the bulk effect. The recovery of shear modulus up to room temperature is similar to that of the residual electrical resistivity after a low temperature neutron irradiation. However, it may be pointed out that in contrast to stage II, in stage III a recovery of shear modulus is observed that is distinctly more pronounced than that of electrical resistivity. The temperature dependence of internal friction, before irradiation, shows a peak at 230°K. After neutron irradiation no peak is observed in the temperature region, from 90 to 300°K. (auth)

30302 LOW TEMPERATURE ELECTRON-IRRADIATION OF β–TIN. McIlwain, T.; Gardiner, R.; Sosin, A.; Myhra, S. (Univ. of Utah, Salt Lake City). Radiat. Eff.; 24: No. 1, 19-27(1975).

High-purity polycrystalline wires of β–tin were irradiated at 5°K by 0.7 to 2.0-MeV electrons. Damage was monitored by electrical resistance measurements taken at 4.2°K. From a comparison of energy-dependent damage rate measurements with electron displacement cross section curves based on the calculations of O. S. Oen (ORNL-3813, May 1965) a threshold displacement energy of 22 ± 2 eV was found. Isochronal anneals revealed three recovery substages below 12°K, accounting for 63% of the total, followed by rather constant recovery up to 180°K. Irradiation at 16°K indicated free interstitial migration below this temperature. A partial characterization of this stage suggests that the largest major substage (10.5°K) may be due to close pair interstitial–vacancy annihilation, although a correlated recovery model cannot be ruled out completely. (auth)

30303 ATOM DISPLACEMENTS AND VOID FORMATION IN PROTON-IRRADIATED TYPE 316 STAINLESS STEEL. Keefer, D. W. (Atomics International Div., Canoga Park, CA). Radiat. Eff.; 24: No. 1, 29-37(1975).

The cross section is calculated for atomic displacement as a function of proton penetration into Type 316 stainless steel. The cross section at a given penetration is reduced from that used in the author's past work. This is the result of new information on proton range, modification of the cross section calculations, and adoption of a higher displacement threshold energy. Swelling, void size, and void density data previously published are plotted against recalculated displacement damage. In general, the data are merely shifted to lower damage levels, and only one conclusion drawn in a previous publication appears to need modification. A short discussion is also included on the effect of voids on proton energy and displacement cross section as a function of proton penetration. (auth)

30304 RADIATION DAMAGE IN Ge PRODUCED BY NOBLE GAS IONS INVESTIGATED BY THE SECONDARY ELECTRON EMISSION METHOD. Holmen, G.; Hoegberg, P.; Buren, A. (Chalmers Tekniska Hoegskola, Goteborg). Radiat. Eff.; 24: No. 1, 39-44(1975).

40-keV Ne, Ar, Kr, and Xe ions were used to bombard Ge single crystals at perpendicular incidence to (110) under clean target conditions. The temperature, dose, and dose rate dependences of the accumulation of disorder were determined. In a low temperature interval, 50 to 150°C, small temperature and dose rate effects on the accumulation of disorder were detected for Ne and Ar but for the other ions there was no such dependence. At temperatures above 150°C, the temperature and dose rate for all types of ions used influence the accumulation of disorder. Different temperatures for the transition from a crystalline to a disordered region were detected for the various dose rates and ions used. Activation energies of 1.45 ± 0.15 eV for the observed defects were calculated. (auth)

30305 RADIATION ENHANCED ANNEALING OF RADIATION DAMAGE IN Ge. Holmen, G.; Peterstroem, S.; Buren, A. Chalmers Tekniska Hoegskola, Goteborg). Radiat. Eff.; 24: No. 1, 45-50(1975).

Ge (110) single crystals heated to a temperature of 228°C were bombardment disordered by 40-keV ions at a dose rate of 6×10^{13} ions/cm^2 s. The enhanced annealing csused by 40-keV Ge ions at a dose rate of 6×10^{11} ions/cm^2 s was studied as a function of dose by measuring the secondary electron yield. The depth distribution of damage was determined by the channeling technique using 500-keV He ions. It is shown that enhanced annealing occurs at the inner part of the damage region and proceeds outwards towards the crystal surface. The dose necessary to anneal a disordered layer completely is about 3.0×10^{15} ions/cm^2. A model for the annealing process is discussed. The maximum path length of the secondary electrons emitted from Ge during the bombardment with 40-keV Ge ions has been determined to be equal to approximately 40 A. (auth)

30306 RADIATION DAMAGE IN Ge PRODUCED AND REMOVED BY ENERGETIC Ge IONS. Holmen, G.; Buren, A.; Hoegberg, P. (Chalmers Tekniska Hoegskola, Goteborg). Radiat. Eff.; 24: No. 1, 51-58(1975).

Single crystals of Ge (110) were bombarded by 40-keV Ge ions at a dose rate of 6.0×10^{13} ions/cm^2 s in the temperature region 50 to 500°C. The secondary electron emission yield was used to study the state of disorder. In accordance with Chadderton's (Rad. Effects; 8: 77 (1971)) damage center nucleation model the growth of disorder can be divided into several dose intervals. Radiation enhanced and thermal annealing characteristics were also studied using a probe ion beam of dose rate 6.0×10^{11} ions/cm^2 s. Evidence for both bombardment enhanced and thermal annealing are established. The bombardment-enhanced annealing of a continuous disordered layer occurs at the inner region of the layer. The temperature dependence of the bombardment enhanced annealing indicates that a thermal step is included in the annealing process. (auth)

30307 DIVACANCY-LIKE TEMPERATURE TRANSFORMATION STAGE AT 230K IN ELECTRON-IRRADIATED N-TYPE GERMANIUM. Jaworowski, A. (Univ., Warsaw); Rzewuski, H. Radiat. Eff.; 24: No. 1, 67-68(1975).

In the paper by Callcott et al (Phys. Rev.; 161: 698 (1967)) the introduction rates of various defects have been studied as a function of bombardment electron energy in n-type Ge irradiated at 4.2°K and annealed to 90°K. The observed energy threshold (0.7 MeV) indicated the possibility of multiple displacements resulting in production of divacancy centers. In this communication new results are presented on the temperature transformation stage at 230°K which has been ascribed to divacancy centers. (auth)

30308 POSITRON ANNIHILATION STUDY OF RADIATION DAMAGE IN PURE ALUMINIUM INDUCED BY ION BOMBARDMENT. Engman, U.; Holmqvist, B. (Aktiebolaget Atomenergi, Studsvik). Radiat. Eff.; 24: No. 1, 65-66(1975).

The positron has been shown to be an efficient probe for investigation of lattice defects in crystals. It has also been used to study voids in neutron irradiated molybdenum. The aim of the present study was to find out the ability of the positron annihilation method in investigation of proton-induced radiation damage in pure aluminium. (auth)

30309 HIGH STRAIN RATE TENSILE PROPERTIES OF TYPE 308 SMA WELD METAL. Steichen, J. M.; Ward, A. L. (Westinghouse Hanford Co., Richland, WA). Weld. J. (N. Y.); 54: No. 4, 130s-135s(Apr 1975).

The high strain rate tensile properties of Type 308 SMA weld metal with controlled residual elements were experimentally determined. Tests were performed on as-welded, thermally aged, and neutron irradiated material at strain rates ranging from 3×10^{-5} to 10 sec^{-1} and temperatures from 316 to 649°C. At test temperatures of 538°C and below, the strength and ductility of the as-deposited weld metal were shown to be insensitive to large variations in strain rate. At 649°C low rate property changes are attributed to the operation of a thermally activated deformation mechanism. Thermal aging at 538°C for durations to 10,000 h significantly reduced the strength and ductility of the weld metal; however, these properties remained strain rate independent. Neutron irradiation at 482°C to a maximum fluence of 4.8×10^{21}

n/cm^2 ($E > 0.1$ MeV) did not greatly alter the tensile properties or strain rate sensitivity of the weld metal. (auth)

30310 OBSERVATION OF POINT-DEFECT CLUSTER FORMATION IN Cu DURING LOW-TEMPERATURE ELECTRON IRRADIATION. Urban, K.; Jaeger, W. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (b); 68: No. 1, K1-K3(1 Mar 1975).

Electron radiation damage in copper between 8 and 300°K was studied using high-voltage electron microscopy. Point-defect clusters were observed to form during irradiation at all temperatures. At 145°K, a fraction of the visible damage consisted of vacancy clusters, showing that vacancies may form clusters at temperatures too low for thermally activated diffusion. The observations are interpreted in terms of radiation-induced diffusion mechanism. (auth)

30311 EFFECT OF REACTOR RADIATIONS ON THE CREEP RESISTANCE AND LONG-TIME STRENGTH OF AUSTENITIC STAINLESS STEEL 0Kh16N15M3B. Pisarenko, G. S.; Kiselevskii, V. N.; Polevoi, D. V.; Lukashev, V. K.; Tsykanov, V. A.; Samsonov, B. V.; Losev, N. P. Strength Mater. (USSR) (Engl. Transl.); 6: No. 4, 399-404(Apr 1974).

Translated from Probl. Prochnosti; 6: No. 4, 3-8(Apr 1974).

An experimental investigation established that reactor radiation ($\Phi = 5.3 \cdot 10^{12}$ neutrons $cm^{-2} \cdot s^{-1}$, $E > 0.85$ MeV) under long-time loading conditions produces a marked reduction in the resistance of steel 0Kh16N15M3B to deformation and fracture at 650°C. The magnitude of the effect of the neutron flux intensity depends on the applied stress level. An equation relating the change in the time-to-rupture of the steel in question to the effective irradiation time was derived. (auth)

30312 EFFECT OF REACTOR RADIATION ON THE RELATIONSHIP BETWEEN THE HEAT RESISTANCE CHARACTERISTICS OF AUSTENITIC STAINLESS STEEL. Kiselevskii, V. N.; Polevoi, D. V. (Inst. of Problems of Strength, Kiev). Strength Mater. (USSR) (Engl. Transl.); 6: No. 4, 444-446(Apr 1974).

Translated from Probl. Prochnosti; 6: No. 4, 46-48(Apr 1974).

An experimental investigation of the steady creep rate, v, and the time to failure, τ, was made for irradiated austenitic stainless steel Kh16N15M2B. The parametric relationship $v^{\delta}\tau = a$ constant was found to hold true for the irradiated steel, although, for unirradiated steel, $v\tau = a$ constant. (PMA)

Other Materials

Refer also to abstracts 29096, 30093, 30122, 30145, 30236, 31541, 31799, 31904, and 32439.

30313 (AED-CONF-74-089-051) NUCLEAR SPIN RELAXATION OF XENON IN LIQUID TELLURIUM. Hadijuana, J.; von Hartrott, M.; Nishiyama, K.; Quitmann, D.; Riegel, D.; Schweickert, H. (Freie Univ. Berlin (F.R. Germany). Fachbereich Physik). 1974. 4p. INIS.

From spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e. V.; Freudenstadt, F. R. Germany (1 Apr 1974).

In liquid Te the changes of the Knight shift and the magnetic relaxation time between the melting point (723 K and 1000°K demonstrate an increasing metallic nature. The quadrupolar relaxation which would provide independent information about structural and/or dynamic behavior, can only be studied using radioactive or impurity atoms since the stable Te isotopes have $I = 0$ or $\frac{1}{2}$. The nuclear spin relaxation of the 8 ms excited nuclear state ^{132}Xe in the Te host has been in this temperature range. (auth)

30314 (CEA-CONF-2771) CHANGES OF THE ELASTIC CONSTANT C_{33} OF PYROLYTIC GRAPHITES INDUCED BY LOW TEMPERATURE IRRADIATION 77 K. Ayasse, J. B.; Bonjour, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Basses Temperatures). Jul 1974. 11p. (CONF-740980-1). Dep. NTIS (US Sales Only) $4.00.

From 4th international carbon and graphite conference; London, UK (27 Sep 1974).

Results are presented on the C_{33} changes of compressed annealed pyrolytic graphites, irradiated with neutrons at 77°K. The method used is the ultrasonic pulse method applied at 6 to 12 MHz. A linear decrease of the C_{33} constant with doses and a relatively monotomous annealing of the effects by warming in the 77 to 300°K range was observed. Results are discussed and related to the theoretical works in this field. (auth)

30315 (CONF-750410-3) GRAPHITES FABRICATED FROM GREEN PETROLEUM PITCH COKES. Horne, O. J.; Kennedy, C. R. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 5p. Dep. NTIS $4.00.

From 169th national meeting, American Chemical Society; Philadelphia, Pennsylvania, USA (6 Apr 1975).

Graphites fabricated from A-240-derived green cokes show similar properties to graphites fabricated from high-quality acicular cokes. Graphite densities equal to or surpassing the densities of bodies fabricated using either the UCC or GLCC fillers were obtainable by the choice of the appropriate A-240 coke preparation temperature and the appropriate binder content. Though a greater degree of anisotropy was present in bodies fabricated from the A-240-derived cokes, reasonably isotropic bodies were prepared using fillers prepared by the heat treatment of pressure-coked A-240 pitch. (auth)

30316 (FZK-9-174) EFFECTS OF REACTOR RADIATION ON THE ENGINEERING PROPERTIES OF ELASTOMERS AND PLASTICS. Wattier, J. B.; Newell, D. M.; Morgan, L. L. (General Dynamics/Fort Worth, Tex. (USA)). Jun 1962. 107p. Dep. NTIS $8.50.

This report is a summary and analysis of the effects of radiation on the properties of certain elastomers and plastics. Irradiations were conducted during 1958–1961 at various temperatures in a variety of media, including air, He, JP4 fuel, Oronite, MIL 7808, and Mixed-4P3E. The data are limited to sheet-stock elastomers and plastics. (auth)

30317 (FZK-263-3) NERVA MATERIALS IRRADIATION PROGRAM. Volume III. GTR Test 17-AGC Materials Test. Thornton, H. G. (General Dynamics/Fort Worth, Tex. (USA)). 30 Dec 1965. 170p. Dep. NTIS $11.50.

Tests were conducted to determine the combined effects of nuclear radiation and liquid hydrogen on the mechanical properties of various organic materials scheduled for use in conjunction with the NERVA propulsion system. The tests consisted of the irradiation and subsequent tensile testing, under several different environmental conditions, of specimens made from the organic materials. Armalon TFE-405-CL-116, Armalon TFE-405-L-112, Armalon FEP-510-L-128, Teflon FEP, and Superpolymer SP-3. The specimens submerged in liquid hydrogen were irradiated in cryogenic tensile test assemblies. Three different dose conditions were achieved by varying the irradiation time and the spacing between the test assembly and the reactor. One run was originally scheduled to accomplish all three specified dose conditions, but a damaged LH_2 transfer line necessitated making two separate runs. After the irradiated specimens were tested, control specimens were tested at nearly identical environmental conditions. Results of an analysis of the mechanical property data indicates that the specimens of the three Armalon materials exhibited a high degree of damage under high-dose conditions. A definite, although generally minor, effect was measured at intermediate levels, and no damage was detected at low dose levels. A similar trend was encountered in the Teflon FEP material, except that a more significant effect was detected at intermediate dose levels. The fifth material tested was Superpolymer SP-3, which exhibited no radiation-induced damage at any of the dose levels. A detailed presentation of the data, along with a statistical analysis, is contained in the text. (auth)

30318 (FZK-347) EVALUATION OF CRYOGENIC INSULATION MATERIALS AND COMPOSITES FOR USE IN NUCLEAR RADIATION ENVIRONMENTS. Materials Test. McMillan, W. D.; Bradbury, H. G.; Carter, H. G.; Lightfoot, R. P.; Kerlin, E. E. (General Dynamics/Fort Worth, Tex. (USA)). May 1968. 266p. Dep. NTIS $16.25.

The report consists of descriptions and discussion of materials, equipment, and procedures and results of mechanical and physical property tests and an application test conducted on cryogenic insulation materials and components under environmental combinations of temperature and radiation. Descriptions of the materials used in the application (insulated dewar) test and of the materials and test specimens for the mechanical property tests are given. In the first test (NRV 1), the insulation assembly (a dewar insulated with foam and corkboard and filled with LH_2), a cryotensile assembly (containing tensile specimens and filled with LH_2), and various materials in an ambient air environment were irradiated. The insulation assembly test was terminated after a maximum exposure of about 1.5×10^{10} ergs/g(C) due to the two detonations that occurred in the corkboard insulation. The cryotensile tester contained lap-shear specimens of urethane and epoxy–polyamide adhesives which were irradiated and tested in LH_2. In addition, specimens of several insulations, films, and adhesives were irradiated in LH_2 and subsequently tested in air at room temperature; similar specimens were also irradiated in air and tested in air. The doses to the specimens ranged from about 3×10^{10} to 9×10^{10} ergs/g(C). The mechanical property tests performed were tensile strength, shear strength, and compressive strength for the foams and corkboard; shear strength and peel strength for the adhesives; and tensile strength and percent elongation for the films.

Gas (nitrogen and oxygen) permeability and water-vapor transmission rate tests were also performed for the vapor-barrier films: MAAM, Tedlar, and urethane-glass laminate. As a result of the detonations in the corkboard insulation of the dewar, two additional irradiation tests (NRV 2 and NRV 3) were performed to generate data for use in the analysis of the detonations and the materials involved. Test NRV 2 consisted of irradiating compression specimens of Insulcork 7326 and two types of urethane foam at 9.0×10^9 to 2.5×10^{10} ergs/g(C). Some of the specimens were sealed in Mylar bags containing dry or moist air or helium and then irradiated in either LN_2 or air at ambient temperature. In postirradiation tests these specimens were evaluated for possible gas-evolution, analyzed for gas composition, and tested for compressive strength. Postirradiation activation analyses of some of the corkboard and foam specimens were performed. Activation analyses were also performed on some stainless steel 321 samples shielded with borated polyethylene. The last test (NRV 3) consisted of irradiating vapor-sealed corkboard and foam blocks and four types of urethane foam in ambient air and LN_2 to doses of about 2×10^{10} ergs/g(C). Postirradiation mechanical-property (tensile, shear, and compression), gas-analysis, and gas-evolution tests were performed and the data were compared with the NRV-1 and NRV-2 results. An analysis of the dewar insulation detonations was made to determine the cause and implications of the detonations that occurred in the corkboard insulation of the dewar (Cube A) after a gamma dose of approximately 10^{10} ergs/g(C). It is concluded that: the Cube A detonations were due to the reaction of radiation-induced H_2 gas with air trapped in the corkboard; the detonations were probably initiated by the pressure-induced rupture of an inner vapor barrier leading to a temperature rise above the detonation limit of a mixture of hydrogen and ozone-enriched air; detonation in freon-blown urethane foam due to radiation-induced hydrogen gas will not occur for doses less than 8×10^{10} ergs/g(C); detonation in urethane-foam insulation due to radiation-induced ozone in liquid air could occur only during dewar warmup and in conjunction with mechanical damage to both the outer vapor barrier and the bonding of the foam to the dewar wall. A test to prove the serviceability of a foam insulation system in a radiation and LH_2 environment was successfully performed on a second dewar (Cube B) insulated with CPR-385-2 polyurethane spray foam insulation. (DLC)

30319 (FZK-355) EVALUATION OF CRYOGENIC INSULATION MATERIALS AND COMPOSITES FOR USE IN NUCLEAR RADIATION ENVIRONMENTS. Rift Tank Test. Quarterly Progress Report, 1 November 1967–31 January 1968. Elliott, R. A. (General Dynamics/Fort Worth, Tex. (USA)). 15 Mar 1968. 41p. Dep. NTIS $5.25.

The RIFT Tank test calls for a 5400-gal RIFT-model tank covered with an insulation to be subjected to repeated cycles of radiation, acoustic vibration, and cryotemperature to simulate the operation of a nuclear engine. Also to be evaluated are valves, pressure transducers, liquid-level sensors, and fission-couple thermocouples. The test program and facilities are described. (DLC)

30320 (TID/SNA-386) RADIATION EFFECTS ON LUBRICANTS FOR NERVA APPLICATION, s110-XLU07-W183-11. French, W. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 39p. Dep. NTIS $5.00.

The lubrication properties of the laminar solids (MoS_2 and $MoSe_2$) are not appreciably altered by high-level radiation. If an inorganic or ceramic binder is employed with a laminar solid, the solid film lubricant can be used in gamma and neutron radiation environments in most applications for which the film are acceptable under non-radiation conditions. Any film employing an organic resin binder will suffer radiation damage consistent with its chemical nature. Organic resin or compounds should not be considered as a binder for NERVA solid film lubricants until they have been tested in NERVA radiation fluences. (auth)

30321 INVESTIGATION OF THE ELECTRONIC STRUCTURE OF YTTRIUM HYDRIDES BY POSITRON ANNIHILATION. Rozenfeld, B.; Debowska, E. (Univ., Wroclaw). Acta Phys. Pol.; A47: No. 1, 37-43(1975).

The angular correlations of positron-annihilation radiation were measured for Y, $YH_{0.99}$, $YH_{2.01}$, $YH_{2.5}$, and YH_3. The angular correlation for free electrons (annihilation with bound electrons of atomic cores was taken into account) was found to be broader than that for yttrium metal and to increase in width with increasing hydrogen concentration to $YH_{2.01}$ in a manner consistent with the "protonic" model of electronic structure. The numbers of free electrons per atom for Y, $YH_{0.99}$, and $YH_{2.01}$ calculated from the distribution of momentum density are respectively: 2.86, 3.89 and 5. Thus, the free-electron model is a useful approximation of the electronic structure of yttrium hydrides, especially for concentrations near $H/Y \approx 2$, but this model fails for higher concentrations. (auth)

30322 ORIENTATION CHANGES IN SELENIUM CRYSTALS GROWING DURING ELECTRON IRRADIATION OF AMORPHOUS FILMS. Bolotov, I. E.; Kozhin, A. V. (Sverdlovsk Inst. of National Economy, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 11, 2363-2366(Nov 1974). (In Russian).

Two stages of growth of crystals were detected. First the usual spherolites with c axis oriented parallel to the film are formed. Then a spontaneous rotation of the c axis (in the newly growing peripheral layers of the crystal) occurs to a direction perpendicular to the film. The regularities of the orientation change were studied. (tr-auth)

30323 SUPERCONDUCTIVITY IN POLYSULFUR NITRIDE $(SN)_x$. Greene, R.L.; Street, G.B. (IBM Research Laboratory, San Jose, California 95193); Suter, L.J. Phys. Rev. Lett. 34: No. 10, 577-579 (10 Mar 1975).

The inorganic crystalline polymer polysulfur nitride has been found to become superconducting with a transition temperature of (0.26 ± 0.03) °K. (auth)

30324 CHANNELING–EFFECT STUDY OF DEUTERON–INDUCED DAMAGE IN Si AND Ge CRYSTALS. Baeri, P.; Campisano, S.U.; Foti, G.; Rimini, E. (Istituto di Fisica, Universita Catania, Italy); Davies, J.A. Appl. Phys. Lett. 26: No. 8, 424-426 (15 Apr 1975).

The disorder produced by 0.3–MeV D^+ in Si and Ge at 80 °K has been analyzed *in situ* by 1.5–MeV D^+ channeling measurements. Differences of about 10% have been found in the $\psi_{1/2}$ values between the undamaged and damaged crystal. On the basis of the Lindhard continuum potential approximation, an average displacement of 0.15 Å from the row is required to explain the observed $\psi_{1/2}$ decrease. (auth)

30325 RESPONSE OF THERMAL FILAMENTS IN VO_2 TO LASER–PRODUCED THERMAL PERTURBATIONS. Jelks, E.C.; Walser, R.M.; Bené, R.W.; Neal II, W.H. (Electronics Research Center, The University of Texas at Austin, Austin, Texas 78712). Appl. Phys. Lett. 26: No. 7, 355-357 (1 Apr 1975).

The response of thermal filaments in thin films of VO_2 to small thermal perturbations induced by a He–Ne laser has been measured. With the aid of additional noise spectrum measurements the sensitivity of a planar device with a 127–μ gap between electrodes is estimated to be approximately 0.6×10^{-9} W/(Hz)$^{1/2}$ at 40 kHz. These devices appear, therefore, to be attractive as fast thermal detectors and may have applications as elements in high–density arrays. Radiance profiles of a thermal filament are also given. (auth)

30326 PHOTOLUMINESCENCE OF SILICON CRYSTALS IRRADIATED WITH FAST ELECTRONS AT LOW TEMPERATURES. Konoplev, V.S.; Konnov, V.M.; Dobrovenskii, V.V.; Gippius, A.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Semicond. 8: No. 9, 1100-1102 (Mar 1975).

A study was made of the photoluminescence spectra of silicon crystals irradiated with $\simeq$300 keV and 1 MeV electrons at T$\simeq$20°K. The primary radiation defects, resulting from this low–temperature irradiation, had little effect on the nonequilibrium carrier lifetime. The characteristic luminescence bands observed at room temperature were not due to simple defects. (auth)

30327 PROCESS OF FORMATION OF RADIATION DEFECTS BY BOMBARDMENT OF SILICON–DOPED GERMANIUM WITH γ RAYS. Abdurakhmanova, S.N.; Vasil'eva, E.D.; Emtsev, V.V.; Mashovets, T.V. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Semicond. 8: No. 9, 1139-1140 (Mar 1975).

It was found that silicon impurities had a considerable influence on the formation of radiation defects in germanium when the ratio of the concentration of silicon to that of group V donors exceeded 10^3. Silicon atoms acted as capture centers of interstitial germanium atoms. (auth)

30328 MODEL OF THE ANNEALING OF DEFECTS GENERATED IN GERMANIUM BY γ–RAY BOMBARDMENT. Abdurakhmanova, S.N.; Dostkhodzhaev, T.N.; Emtsev, V.V.; Mashovets, T.V. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Semicond. 8: No. 9, 1144-1147 (Mar 1975).

An analysis is made of the results of an investigation of isochronous annealing of germanium doped with group V impurities and exhibiting a conversion of the type of conduction under the influence of γ–ray bombardment. The data on the annealing of the uncoverted material are also analyzed. It is shown that the annealing of radiation defects can be described by a model suggested earlier for the formation of radiation defects in n–type Ge. This model is based on the assumption that the defects consist of vacancy–donor and divacancy–donor complexes, and of interstitial group V impurity atoms in two configurations. (auth)

30329 NEUTRON RADIATION DAMAGE IN SOME BIREFRINGENT CRYSTALS. Wong, C. F. (Department of Physics, Queensland Institute of Technology, Brisbane, Australia). Phys. Lett., A; 50: No. 5, 346-347(30 Dec 1974).

Natural quartz and natural calcite were irradiated with fast neutrons. Radiation effects caused structural distortion in quartz and produced color centers in calcite. (auth)

30330 THEORY OF QUANTUM DIFFUSION IN SOLID HYDROGEN AND DEUTERIUM. Toronto; Univ. of Toronto (1971). 122p.

Thesis.

A theoretical investigation of the phenomenon of quantum diffusion in solid hydrogen and deuterium has been performed. The observed quantum diffusion is shown to be due to resonant ortho-para conversion processes which result from the magnetic dipole-dipole interaction between nuclear spins in neighboring molecules. A basic quantity characterizing the quantum diffusion process is the jump frequency, ν, of an ortho excitation to jump one lattice distance. This quantity is calculated by assuming that the magnetic interaction modulated by the quadrupole-quadrupole coupling is characterized by a Gaussian correlation function and calculating the zeroth and second moments. This method is carried out for low concentrations ($\leq$1%) assuming a random distribution of the ortho impurities. Temperature dependence of the quantum diffusion process has also been investigated. (CA)

30331 LUMINESCENCE SPECTRA OF NITROGEN IN SOLID ARGON. I. Experiment. Jodl, H. J.; Bruno, R. (Technische Univ., Munich). Phys. Status Solidi (b); 67: No. 1, 191-197(1 Jan 1975).

The x-ray stimulated luminescence spectra of Ar crystals having 0.01 and 5% N_2 impurities were studied at 4.2 and 77°K in the region of the Vegard-Kaplan ($A^3\Sigma_u^+ \rightarrow X^1\Sigma_g^+$) bands. Each band of the 5% N_2/Ar system, at 4.2°K, was composed of three, almost equispaced, peaks. The fine structure was defined by a two-peak asymmetric sideband, between 25 and 180 cm^{-1}, to the red of the N_2 electronic-vibrational transition. At other impurity concentrations and crystal temperatures, different relaxation rates were found but no fine structure was observed. The whole Vegard-Kaplan band system for N_2/Ar at 4.2°K was found to be shifted by (128 ± 15) cm^{-1} to the red of ν_{00}, the free molecule transition. (auth)

30332 OPTICAL PROPERTIES AND CHEMICAL DECOMPOSITION OF HALIDES AND LAYER STRUCTURES. II. Defects, Chemical Decomposition, and Photographic Phenomena. Tubbs, M. R. (Univ. of Warwick, Coventry, Eng.). Phys. Status Solidi (b); 67: No. 1, 11-49(1 Jan 1975).

A review of data and information is presented on the crystal structures of mx_2 and mx_3 layer halides, polytypism, optical and opto-electronic properties, and models for electronic structure. Proven techniques for preparing good single crystals of many layer halides are now available and progress is being made in understanding the behavior of lattice defects in such samples. The purity and perfection of available crystals are not yet fully adequate to understand the origin of defect energy levels, carrier trapping processes, and luminescence emissions. However, the recent and growing interest in HgI_2 as a radiation detector may well lead to further work on carrier mobilities and defect states in this material and in other layer halides with potential for similar applications. Further work on the electronic structure of layer halides is beginning to give useful data on the correlation between measured optical and opto-electronic properties and the first electron energy band calculations. These first steps in the intercomparison of theory and experiment should be continued, on the one hand, with further exploratory work on other layer halides to provide a broader base for comparison, and, on the other, with detailed work on materials typical of the two main electronic types—say PbI_2 or BiI_3 and CdI_2 or HgI_2. Research of the latter type will involve detailed electro-absorption, modulation, and pressure experiments, with relativistic energy band calculations. New areas of research should include studies of the optical properties of magnetic di- and tri-halides and of non-linear phenomena associated with laser excitation. The interesting radiation damage phenomena seen in layer halides should stimulate further interest in the electron microscopy and microstructure of these materials with continuing studies of dislocation phenomena leading to a better understanding of polytypism and the processes leading to point defect condensation. The growing interest in new photographic and holographic processes based on the photolysis of layer halides should lead to further research on the mechanisms of photodecomposition and the role of impurities, reducing agents, and metal sensitization in these phenomena. (auth)

30333 BAND STRUCTURE OF SOLID o-H_2 WITH THE MOLECULAR TIGHT-BINDING AND OPW METHOD. Pastori Parravicini, G. (Univ., Pisa, Italy); Villa, I.; Vittori, M. Phys. Status Solidi (b); 67: No. 1, 345-354(1 Jan 1975).

The band structure of fcc solid hydrogen is computed using the molecular tight-binding method for the valence band and the molecular orthogonalizing plane waves (OPW) method for the conduction bands. The direct energy gap is found to be 15.1 eV and corresponds to the allowed transition $L_1^+ \rightarrow L_2^-$. The pressure dependence of relevant states is obtained and it is shown that the energy gap decreases with pressure. Some features of the far vacuum ultraviolet excitation spectrum are qualitatively interpreted. (auth)

30334 PHENOMENOLOGICAL MODEL FOR THE BUILD-UP OF A SPACE CHARGE IN DIELECTRICS IRRADIATED WITH FAST ELECTRONS. Evdokimov, O. B.; Gusel'nikov, V. N. (Tomsk Polytechnical Inst., USSR). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 5, 359-362(1974).

Translated from Khim. Vys. Energ.; 8: No. 5, 423-427(1974).

A phenomonological model has been developed for the build-up of a space charge (SC) in dielectrics during their irradiation with fast electrons. In addition to the source of thermalized electrons the model takes into account the formation of additional charges arising from ionization of the medium. Both negative and positive carriers participate in charge transfer. A general analytical expression is obtained which relates the SC characteristics with the dielectric parameters and the irradiation conditions. A more detailed analysis is carried out for the case of efficient charge build-up, for which a simple expression is obtained relating the SC with the dielectric parameters and irradiation conditions and which is in accordance with experimental results. (auth)

30335 BEHAVIOR OF ULTIMATE STORED RADIONUCLIDES IN THE FORM OF GLASS OR GLASSY MATRIX PRODUCT. Bonniaud, R.; Pacaud, F.; Sombret, C. (CEA Centre de Marcoule, 30-Bagnols-sur-Ceze (France). Service des Ateliers Pilotes). pp 745-762 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The study of the physicochemical properties of the materials produced in fission-product solution vitrification is of great significance with respect to the ultimate storage. To this end, thermal stability, radiation stability and aqueous liquid leaching were particularly investigated. The VULCAIN cell in which glass blocks weighing 2 kilograms can be produced is described. The results connected with water leaching at several temperatures with 10^{11} rad radiation exposure and with various thermal processings are given. (FR)

30336 ELECTROSTATIC FIELD AT THE RARE EARTH ION SITE IN LANTHANUM COMPOUNDS DOPED WITH Eu^{3+}. Louat, A.; Linares, C.; Blanchard, M. (Lyon-1 Univ., 69-Villeurbanne (France)). Compt. Rend., Ser. A, B; 279: No. 3, 63-66(15 Jul 1974). (In French).

The B_n^m electrostatic parameters were calculated in $LaCl_3$, $LaAlO_3$, La_2O_3, and La_2O_2S and the contribution of ligands to the total field was studied. (FR)

30337 THERMAL SPECTRUM OF THE DE-ACCOMMODATION OF A MAGNETITE AFTER NEUTRON IRRADIATION AT LOW TEMPERATURE. Dindoun, S. S.; Raitman, E. A. (AN Latvijskoj SSR, Riga. Inst. Fiziki); Merceron, T. (Centre National de la Recherche Scientifique, 92-Meudon-Bellevue (France). Lab. de Magnetisme et de Physique du Solide). Compt. Rend., Ser. A, B; 279: No. 4, 91-94(22 Jul 1974). (In French).

It was shown that the neutron irradiation of magnetite induces a new de-accommodation phenomenon that is due to interstitials, at about 250K. (FR)

30338 SPATIAL DISTRIBUTION OF DEFECTS PRODUCED BY BORON ION IMPLANTATION OF SILICON. Yudin, V. V.; Kurinny, V. I.; Akimov, Y. S.; Karatsyuba, A. P. Radiat. Eff.; 24: No. 1, 59-61(1975).

A simple technique for the study of the spatial distribution of the damage produced by ion implantation of silicon was developed. The damage depth distribution for 40-keV boron ions in silicon was studied at irradiation doses from 7×10^{11} to 3.9×10^{14} ions/cm^2 and the relative defect peak depth $R_d/R_p = 0.85$ determined. An increase of layer conductivity as the surface part of the implanted layer is removed has been revealed. This effect is caused by the presence of radiation defects in the surface region of the layer. The "electrical" cluster diameter is about 28 Å and the overlapping cluster dose is close to 1×10^{13} ions/cm^2. (auth)

30339 OPTICAL ABSORPTION AND THERMOLUMINESCENCE OF HIGH AC FIELD TREATED AND X-RAY IRRADIATED POTASSIUM CHLORIDE SINGLE CRYSTALS. Govinda, S.; Rao, K. V. (Indian Inst. of Tech., Kharagpur). Solid State Commun.; No. 3, 297-299(1 Feb 1975).

Optical absorption and thermoluminescence (TL) output measurements were made on high ac field treated and x-irradiated KCl single crystals. A substantial enhancement both in F-band peak absorption as well as in TL output was observed. (auth)

30340 FINE-STRUCTURE SPLITTING IN TRIPLET STATES OF THE SELF-TRAPPED EXCITON IN ALKALI HALIDES. Call, P. J.; Hayes, W.; Huzimura, R.; Kabler, M. N. (Oxford Univ.). J. Phys., C (London); 8: No. 4, L56-L59(21 Feb 1975).

By exploiting optical selection rules in a microwave-optical double-resonance experiment, it is shown that the fine-structure parameter D for the lowest triplet state of the self-trapped exciton changes sign from (+) to (−) along the sequence of crystals from alkali iodides to fluorides. This results from interplay between a positive spin-orbit-exchange interaction and a negative magnetic dipole-dipole interaction. (auth)

30341 PREPARATION OF BERYLLIUM HYDRIDE. Shephard, L. H. Jr.; Kobetz, P.; Laran, R. J.; Johnson, R. W. Jr. (to Ethyl Corp.). US Patent 3,864,464. 4 Feb 1975. Filed Date 27 Jan 1965. 6p.

A process was developed for the preparation of beryllium hydride which comprises reacting, at a temperature of from 75° to about 200°C, an organodiborane of the general formula $R_4B_2H_2$ with a dihydrocarbyl beryllium compound of the general formula R'_2Be. R and R′ represent radicals selected from the group consisting of alkyl, monocyclic cycloalkyl and monocyclic aryl radicals containing from 1 to about 10, 5 to about 10 and 6 to about 10 carbon atoms. Beryllium hydride is recovered from the reaction product. (auth)

30342 OPTICAL DETECTION OF EXCITON EPR IN FLUORITE CRYSTALS. Call, P. J.; Hayes, W.; Kabler, M. N. (Oxford Univ.). J. Phys., C (London); 8: No. 4, L60-L62(21 Feb 1975).

Irradiation of alkaline earth fluorides with x-rays produces a strong fluorescence band in the ultraviolet. This band shows pronounced polarization effects when the crystals are placed in a magnetic field. EPR experiments on excited states using optical detection show that perturbed excitons with the molecular configuration of an H center contribute to the fluorescence. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 28983.

30343 (NMC-0008) STUDIES ON THE NUCLEAR-MATTER MANAGEMENT SYSTEM. (Nuclear Material Control Center, Tokyo (Japan)). Mar 1973. 80p. INIS.

As a part of the work in the peaceful uses of atomic energy, the Nuclear Material Control Center undertook the study on the nuclear material management system in 1972. Of the four groups in the Nuclear Material Management System Committee organized for the purpose, the "system group" studied the development of statistical methods for evaluation of the nuclear-material flow (including the data generators), and the origins of MUF (material unaccounted for). The results of studies by the system group are described. The purpose is to establish the same system in Japan, and also to make for safeguards inspection by IAEA. (INIS)

30344 NON-PROLIFERATION OF NUCLEAR WEAPONS AND THE EXPORT OF NUCLEAR MATERIALS AND EQUIPMENT. Meerburg, A. J. (Bureau Ontwapening en Internationale Vredesvraagstukken van het ministerie van Buitenlandse Zaken). Atoomenergie Haar Toepass.; 16: No. 12, 287-288(Dec 1974). (In Dutch).

Various international agreements concerning the non-proliferation of nuclear weapons are reviewed. The control system operated by the IAEA is discussed. The situation vis-a-vis the Netherlands is outline, with special reference to a so called "trigger list" of special items. These are itemized under the headings: reactors and equipment therefor, non-nuclear materials for reactors, development plant, fissile material fabrication, uranium separation equipment, and nuclear materials. In conclusion, a list of countries is given detailing those which have agreed to maintain the existing export regulations. (auth)

30345 TAMPER-PROOF SEAL SYSTEM. Jehenson, P. S.; Vos, G. J. P. (to European Atomic Energy Community). US Patent 3,869,609. 4 Mar 1975. Filed Date 3 Aug 1972. 4p.

A seal system is described comprising a seal, preferably a two-part capsule with an internal closure clip, made from a base material containing a random non-homogeneous mixture of foreign substances, enabling the identity of the seal and damage to it to be determined spectrographically by a non-destructive apparatus for detecting x-ray fluorescence. (Official Gazette)

Disposal and Storage

Refer also to abstracts 29169, 29175, 29176, 29883, and 31797.

30346 (ARH-ST-110B) WASTE MANAGEMENT AND TRANSPORTATION TECHNOLOGY DEVELOPMENT. Quarterly Report, October 1974-December 1974. Kupfer, M. J.; Van Slyke, W. J. (Eds.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-2130. 123p. Dep. NTIS $5.25.

This document is the second in a series of quarterly progress reports on activities in support of management of Hanford high-level waste. It covers the period October through December 1974. A variety of specific topics are discussed. They can be grouped in the areas of: salt cake retrieval; tank integrity; storage system improvements; waste immobilization; and conversion of failed, contaminated equipment to safe storage forms. (auth)

30347 (BNWL-B-223-1) ADVANCED WASTE MANAGEMENT STUDIES PROGRESS REPORT, JUNE-JULY 1972. Platt, A. M. (Comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1972. Contract AT(45-1)-1830. 38p. Dep. NTIS $5.00.

PNL is studying and evaluating all currently envisioned, potential, long-term, radioactive waste management concepts. The purpose of the study is to identify feasible long-term waste management systems and their components, identify the research and development necessary for their establishment, and estimate the schedule and costs associated with selected systems. The study is being conducted so that alternative waste management systems can be evaluated on common bases and the future course of development for long-term management systems can be planned. Three basic types of waste management concepts are under study: terrestrial disposal; extraterrestrial disposal; and transmutation processing. The terrestrial concepts involve disposal of wastes in geologic formations, polar ice caps, and seabeds. The extraterrestrial concept involves disposal of wastes to various locations in space. Transmutation involves partial elimination of some offensive waste nuclides. There are several sub-concepts within each major concept (e.g., transmutation by accelerators, fission reactors, or fusion reactors). Each concept is being evaluated in terms of the total waste management system needed to support it. (auth)

30348 (BNWL-B-223-2) ADVANCED WASTE MANAGEMENT STUDIES PROGRESS REPORT, AUGUST-SEPTEMBER 1972. Hansen, J. E. (Comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1972. Contract AT(45-1)-1830. 50p. Dep. NTIS $5.50.

PNL is studying and evaluating all currently envisioned, potential, long-term, radioactive waste management concepts. The purpose of the study is to identify feasible long-term waste management systems and their components, identify the research and development necessary for their establishment, and estimate the schedule and costs associated with selected systems. The study is being conducted so that alternative waste management systems can be evaluated on common bases and the future course of development for long-term management systems can be planned. Three basic types of waste management concepts are under study: terrestrial disposal; extraterrestrial disposal; and transmutation processing. The terrestrial concepts involve disposal of wastes in geologic formations, polar ice caps, and seabeds. The extraterrestrial concept involves disposal of wastes to various locations in space. Transmutation involves partial elimination of some offensive waste nuclides. There are several sub-concepts within each major concept (e.g., transmutation by accelerators, fission reactors, or fusion reactors). Each concept is being evaluated in terms of the total waste management system needed to support it. (auth)

30349 (BNWL-B-223-3) ADVANCED WASTE MANAGEMENT STUDIES PROGRESS REPORT, OCTOBER-NOVEMBER 1972. Hansen, J. E. (Comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1972. Contract AT(45-1)-1830. 85p. Dep. NTIS $7.25.

PNL is studying and evaluating all currently envisioned, potential, long-term, radioactive waste management concepts. The purpose of the study is to identify feasible long-term waste management systems and their components, identify the research and development necessary for their establishment, and estimate the schedule and costs associated with selected systems. The study is being conducted so that alternative waste management systems can be evaluated on common bases and the future course of development for long-term management systems can be planned. Three basic types of waste management concepts are under study: terrestrial disposal; extraterrestrial disposal; and transmutation processing. The terrestrial concepts involve disposal of wastes in geologic formations, polar ice caps, and seabeds. The extraterrestrial concept involves disposal of wastes to various locations in space. Transmutation involves partial elimination of some offensive waste nuclides. There are several sub-concepts within each major concept (e.g., transmutation by accelerators, fission reactors, or fusion reactors). Each concept is being evaluated in terms of the total waste management system needed to support it. (auth)

30350 (BNWL-B-223-4) ADVANCED WASTE MANAGEMENT STUDIES PROGRESS REPORT, DECEMBER, 1972-JANUARY, 1973. Hansen, J. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 95p. Dep. NTIS $7.25.

PNL is studying and evaluating all currently envisioned, potential, long-term, radioactive waste management concepts. The purpose of the study is to identify feasible long-term waste management systems and their components, identify the research and development necessary for their establishment, and estimate the schedule and costs associated with selected systems. The study is being conducted so that alternative waste management systems can be evaluated on common bases and the future course of development for long-term management systems can be planned. Three basic types of waste management concepts are under study: terrestrial disposal; extraterrestrial disposal; and transmutation processing. The terrestrial concepts involve disposal of wastes in geologic formations, ice sheets, and seabeds. The extraterrestrial concept involves disposal of wastes to various locations in space. Transmutation involves partial elimination of some offensive waste nuclides. There are several sub-concepts within each major concept (e.g., transmutation by accel-

erators, fission reactors, or fusion reactors). Each concept is being evaluated in terms of the total waste management system needed to support it. (auth)

30351 (BNWL-B-223-5) ADVANCED WASTE MANAGEMENT STUDIES PROGRESS REPORT, FEBRUARY-MARCH 1973. Schneider, K. J. (Comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 80p. Dep. NTIS $7.00.

PNL is studying and evaluating all currently envisioned, potential, long-term, radioactive waste management concepts. The purpose of the study is to identify feasible long-term waste management systems and their components, identify the research and development necessary for their establishment, and estimate the schedule and costs associated with selected systems. The study is being conducted so that alternative waste management systems can be evaluated on common bases and the future course of development for long-term management systems can be planned. Three basic types of waste management concepts are under study: terrestrial disposal; extraterrestrial disposal; and transmutation processing. The terrestrial concepts involve disposal of wastes in geologic formations, polar ice caps, and seabeds. The extraterrestrial concept involves disposal of wastes to various locations in space. Transmutation involves partial elimination of some offensive waste nuclides. There are several sub-concepts within each major concept (e.g., transmutation by accelerators, fission reactors, or fusion reactors). Each concept is being evaluated in terms of the total waste management system needed to support it. (auth)

30352 (BNWL-B-223-6) ADVANCED WASTE MANAGEMENT STUDIES PROGRESS REPORT, APRIL-MAY 1973. Schneider, K. J. (Comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 134p. Dep. NTIS $9.75.

PNL is studying and evaluating all currently envisioned, potential, long-term, radioactive waste management concepts. The purpose of the study is to identify feasible long-term waste management systems and their components, identify the research and development necessary for their establishment, and estimate the schedule and costs associated with selected systems. The study is being conducted so that alternative waste management systems can be evaluated on common bases and the future course of development for long-term management systems can be planned. Three basic types of waste management concepts are under study: terrestrial disposal; extraterrestrial disposal; and transmutation processing. The terrestrial concepts involve disposal of wastes in geologic formations, polar ice caps, and seabeds. The extraterrestrial concept involves disposal of wastes to various locations in space. Transmutation involves partial elimination of some offensive waste nuclides. There are several sub-concepts within each major concept (e.g., transmutation by accelerators, fission reactors, or fusion reactors). Each concept is being evaluated in terms of the total waste management system needed to support it. (auth)

30353 (BNWL-B-223-7) ADVANCED WASTE MANAGEMENT STUDIES PROGRESS REPORT, MAY-JUNE, 1973. Schneider, K. J. (Comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 67p. Dep. NTIS $6.50.

PNL is studying and evaluating all currently envisioned, potential, long-term, radioactive waste management concepts. The purpose of the study is to identify feasible long-term waste management systems and their components, identify the research and development necessary for their establishment, and estimate the schedule and costs associated with selected systems. The study is being conducted so that alternative waste management systems can be evaluated on common bases and the future course of development for long-term management systems can be planned. Three basic types of waste management concepts are under study: terrestrial disposal; extraterrestrial disposal; and transmutation processing. The terrestrial concepts involve disposal of wastes in geologic formations, ice sheets, and seabeds. The extraterrestrial concept involves disposal of wastes to various locations in space. Transmutation involves partial elimination of some offensive waste nuclides. There are several sub-concepts within each major concept (e.g., transmutation by accelerators, fission reactors, or fusion reactors). Each concept is being evaluated in terms of the total waste management system needed to support it. (auth)

30354 (PB-237361) QUARTERLY AWARDS LISTING GRANTS ASSISTANCE PROGRAMS, FOURTH QUARTER OF FISCAL YEAR 1974. Report for 1 May-1 July 1974. (Environmental Protection Agency, Washington, D. C. (USA)). 1 Sep 1974. 210p. (EPA-GAD-1-74-004). NTIS $7.25.

The publication lists all the grants awarded by the United States Environmental Protection Agency in the fourth quarter of fiscal year 1974. The format is to have the initial sort of states, then by the various grant programs having awards to grantees in the state. Each entry consists of the identification of the grantee, the program area for the project, such as air or water, the grant title, grant number, award date, and the dollar amount. (GRA)

30355 (WANL-TME-693) JUSTIFICATION: SECOND FLOOR STORAGE ROOM 215 IN REACTOR ASSEMBLY. Pollack, N. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Feb 1964. 6p. Dep. NTIS $4.00.

The storage of fuel arrays on the second floor of the Reactor Assembly Laboratory near Pittsburgh, Pa. is justified by reviewing the flood history of that region. (LCL)

30356 HIGH LEVEL WASTE MANAGEMENT. van Geel, J. N. C. Atoomenergie Haar Toepass.; 16: No. 12, 281-286(Dec 1974).

The quantity of radioactive wastes generated in the world will increase in the near future as nuclear power will assume an increasingly important role in meeting electrical energy requirements. The wastes of primary concern, designated as "high-level wastes" principally consist of fission-product concentrates that result from the processing of spent reactor fuels. They have to be handled in a manner: (1) that they will be contained outside the biosphere as long as they could endanger the health and safety of the population; and (2) that they will not have any adverse impact on man's environment or on the ecology. In November 1972, an International Symposium held in Paris on "Management of Radioactive Wastes from Fuel Reprocessing" showed that no uniform policy of nuclear waste management exists yet. In general, the final step in radioactive waste management practices can be divided into two major categories: retrievable storage and disposal. The term retrievable storage means storage of the wastes in a location and in a form that would permit recovering of the waste if desired in the future. The term disposal, on the other hand, is usually applied to procedures involving the isolation of the wastes from the biosphere in such a manner that surveillance is unnecessary and recovery of the waste considered impractical and not required. (auth)

30357 DISPOSAL PROCEDURES OF ^{239}Pu CONTAMINATED WASTE. Conche, R.; Hayet, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section du Plutonium Irradie). pp 721-743 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Treatment and storage of waste contaminated by ^{239}Pu need special care. The use of shielded boxes is entailed by the activity and the very long half-life of ^{239}Pu (24000y). In the laboratory of Radiometallurgy at Fontenay-aux-Roses, a system has been developed in order to eliminate the waste directly from the hot cells. This system consists of a volume reduction of the crushable wastes, containment in shielded boxes, transportation of the wastes to the decay area, or a final storage by way of shielded transfer devices. (FR)

30358 CRITERIA FOR THE ASSESSMENT OF POSSIBLE METHODS FOR LONG-TERM STORAGE OF RADIOACTIVE WASTES IN THE GDR. Richter, D. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). pp 679-702 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Considering the potential hazards caused by irradiated nuclear fuels as well as the principles of radiation protection with regard to permissible releases into the environment, safety and assessment criteria are described which are used in studying the design of a system of long-term storage of radioactive wastes in the GDR including the possibilities of storing liquid and gaseous radioactive wastes in the ground. Certain problems, e.g., safety aspects of final storage in an abandoned salt mine, are discussed. (FR)

30359 A STORAGE SOLUTION FOR PRECONDITIONED SOLID RADIOACTIVE WASTES. Argiero, L.; Lo Moro, A.; Panciatici, G. (Centro Applicazioni Militari Energia Nucleare, S. Piero a Grado (Italy)). pp 763-768 of The Containment of Radioactivity and the

Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Temporary confinement of wastes may be today a valid solution for particular situations, varying from country to country. The main data concerning the actual situation of the Italian wastes management situation characterized by a small volume production, furthermore scattered in many small and medium sized production centers, are summarized. It is very difficult to evaluate the future production because of disputable forecasts concerning the needs of electronuclear energy. With this perspective, it is explained through environment and management pertaining data, the solution for a middle termed confinement of wastes, adopted by "Centro Applicazioni Militari Energia Nucleare". (FR)

30360 TECHNOLOGY ASSESSMENT METHODOLOGY APPLIED TO HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT. Logan, S. E. Albuquerque, NM; Univ. of New Mexico (1974). 290p. University Microfilms Order No. 75-5876.

Thesis (Ph. D.).

A Radioactive Waste Management Systems Model was developed, which evaluates damage charges for potential environmental and population exposure damages. Parallel branches of the model represent the management phases: residuals treatment (at the reprocessing plant, transportation to repository, repository operations, and long term storage at the repository. Each branch includes a fault tree analysis for determination of release probabilities and magnitudes, an environmental model for calculating transport of radionuclides through environmental pathways to man-dose and other environmental effects, and an economic model for evaluation of associated damage charges. A reference waste blend, 80% from enriched uranium fuel and 20% from plutonium recycle fuel is employed, using properties obtained with the ORIGEN Code. A selection process is presented for screening the large number of radionuclides in the waste. Twenty-six fission product and heavy metal nuclides are selected which constitute almost all of the ingestion and inhalation hazard during each time interval through one million years. Application of the assessment methodology to three disposal concepts is studied. These are: disposal in bedded salt, in a nuclear chimney, and by rock-melting-capsules. Analysis and a design for the latter concept, proposed by the author, is presented. Implementation of the systems model is with a computer program AMRAW which uses a network of transfer coefficients and receptors to determine and collect probabilistic dose and environmental effects from each branch of the model and to calculate the resulting long term total damage and marginal damage costs. Allocation of these costs is made to elements initially present in the waste. A simplified case with Sr-90, Pb-210, and Pu-239 is used to demonstrate the program. It is concluded that the complete sequence of high-level radioactive waste management operations can be described by a simple systems model. The model, with associated methodology, provides the means for bringing together interdisciplinary efforts in assessing environmental impacts of various waste management concepts and serves as an alternative to a long term pilot study. Feed-back of residuals charges to the fuel reprocessing operations may serve as an economic incentive for selection of disposal methods for minimum social cost, and reduction of residuals through improved recovery of fuel actinides and recovery of additional actinides. Recommendations for additional work required to fully implement the systems model are made. These include research in the fields of geology and hydrology, biology, engineering, economics, and geography. (Diss. Abstr. Int., B)

Handling Equipment and Procedures

30361 (NDS-22) IRRADIATED FUEL HANDLING SYSTEM 43 EXTENDED CONCEPTUAL DESIGN. Progress Report, September 12, 1969. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1970. 143p. Dep. NTIS $10.25.

A conceptual design of a system for handling FFTF irradiated fuel is presented. Technical discussions on the following are presented: process study; cleaning evaluation; waste cutting evaluation; surge storage evaluation; interface requirements; fuel disposition evaluation; radiation levels; state-of-the art review; layout drawings; equipment list; and System 23 integration. (TFD)

30362 (NTO-A-0029) NERVA TEST OPERATIONS CRITICALITY CONTROL MANUAL. Haertjens, B. L. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Jul 1966. 40p. Dep. NTIS $5.00.

NERVA Test Operations at NRDS involve the handling, transporting, and storing of various amounts of fissionable material. This manual establishes the basic rules, guides, and limits for the handling, transporting, and storage of fissionable material in any form. It is an aid to line management in fulfilling their responsibility for maintaining nuclear safety. (LCL)

30363 (RDT-E-12-3) PRELIMINARY DRAFT: RTD STANDARD MAINTENANCE CASK, MAINTENANCE FLOOR VALVE AND ASSOCIATED HANDLING EQUIPMENT, FFTF. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 51p. Dep. NTIS $5.75.

The requirements for the design, fabrication, and quality assurance necessary for the procurement of maintenance casks, maintenance floor valves, and associated handling equipment for use in handling both radioactive and sodium-contaminated equipment in LMFBR-type facilities are presented. (LCL)

30364 (WANL-TME-185) WESTINGHOUSE ASTRONUCLEAR LABORATORY CRITICALITY HAZARDS CONTROL GUIDE. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1962. 20p. Dep. NTIS $4.00.

Basic rules and limits for the safe handling of fissionable materials at the Westinghouse Astronuclear Laboratory are established and the basic format for Nuclear Safety Manuals for specific handling areas is presented. (LCL)

30365 (WANL-TME-185(Rev.A)) WESTINGHOUSE ASTRONUCLEAR LABORATORY NUCLEAR SAFETY GUIDE. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1966. 21p. Dep. NTIS $4.25.

Basic rules and limits for the safe handling of fissionable materials at the Westinghouse Astronuclear Laboratory are established and the basic format for Nuclear Safety Manuals for specific handling areas is presented. (LCL)

30366 (WANL-TME-185(Rev.B)) WESTINGHOUSE ASTRONUCLEAR LABORATORY NUCLEAR SAFETY GUIDE. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 20p. Dep. NTIS $4.00.

Basic rules and limits for the safe handling of fissile materials at the Westinghouse Astronuclear Laboratory are established and the basic format for Nuclear Safety Manuals for specific handling areas is presented. (LCL)

30367 (WANL-TME-437(Rev.1)(Sect.7)(Add.2)) REACTOR ASSEMBLY LABORATORY CRITICALITY HAZARDS CONTROL PROCEDURES. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1964. 31p. Dep. NTIS $4.75.

Procedures which maintain adequate criticality control and which insure safety from accidental criticality during reactor assembly operations and during the handling of enriched U within and between work areas in the Reactor Assembly Laboratory at the Westinghouse Astronuclear Laboratory are presented. (LCL)

30368 AN APPARATUS FOR STORING AND PROCESSING FISSILE SUBSTANCES. Dubovsky, B. G.; Bogatyrev, V. K.; Vladykov, G. M.; Sviridenko, V. Y. French Patent 2,198,224/A/. 29 Aug 1972. 11p. (In French).

The invention concerns apparatus for the storage and processing of fissile materials. The apparatus has a space containing the fissile material and a protection shield formed by a layer (a) of a neutron-absorbing material and a layer (b) of neutron-moderating material placed downstream. The layer (a) is placed in direct proximity to the space containing the fissile material. The layer (b) is formed by alternation of projection and cavities of the side of layer (a). The apparatus is designed for use in chemical plants processing fissile materials such as U and Pu. (FR)

30369 SPECIFICATION OF COMPONENTS FOR THE STANDARDIZATION OF CONTAINMENT SYSTEMS. Joint Work of Industry, CEA, EDF, and Standardization Organizations. Pradel, J.; Vertut, J.; Lefort, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection); Artur, M. (Societe A. C. B., 92 - Bagneux (France)). pp 187-192 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

A committee for the selection of instrumentation for use in hostile environments was created in 1972. Four working groups were set up to study criteria for the classification of containment systems; testing of containment efficiency; testing of shielding; and ventilation technology. Their purpose is to provide information to manufacturers and users and the specification of data for the selection and standardization of equipment. The containment classification working group has analyzed the data to be supplied to the manufacturers in the general characteristics of the various types of containment systems, and the technological character-

istics which could be standardized. A table for selection of the characteristics of a containment has been established. To make its use easier, a booklet of information and a glossary of the terms used shall be written. The containment efficiency working group is drafting a classification of containment systems according to their leak rate, complying with and generalizing the previous CEA classification. The shielding testing working group will define the criteria of acceptance relative to the homogeneity margins of shielding. The ventilation technology working group will define containment ventilation systems and their respective regulations and filtration, develop methods of operational testing, and determine ventilation categories. (FR)

Transportation

30370 (COO-2535-1) EXPOSURE OF AIRPORT WORKERS TO RADIATION FROM SHIPMENTS OF RADIOACTIVE MATERIALS AT THE ST. LOUIS INTERNATIONAL AIRPORT. [Period Covered]: November 15, 1974–February 15, 1975. Luszczynski, K. (Washington Univ., St. Louis, Mo. (USA)). 1975. Contract AT(11-1)-2535. 109p. Dep. NTIS $8.50.

Results are presented on a survey of the exposure of cargo agents to radiation relating to passage of radioactive packages through the St. Louis International Airport. Exposures of selected cargo agents have been determined on a number of individual shifts during which activities with regard to radioactive packages were closely monitored. The results obtained indicate that a major part of the exposure of cargo agents arises from direct interaction with radioactive packages during processing, handling, and moving of these packages, but that some of the exposure is incidental. A quantitative basis is developed for making order-of-magnitude estimates of exposure at other airports and some implications for processing and handling of radioactive packages at airports are given. (auth)

30371 (DPSPU-68-190A) TESTS OF HEAVY WATER DRUMS. Long, W. W.; Coon, M. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA)). Jun 1969. Contract AT(07-2)-1. 27p Dep. NTIS $4.50.

A proposed shipment to Canada of heavy water containing more than 5000 μCi of tritium oxide per ml will require that a special shipping permit be obtained from the Department of Transportation. Therefore, the 53- to 55-gallon capacity drums used at SRP for storing and shipping heavy water were tested under conditions similar to normal conditions of transport and hypothetical accident conditions. The results of the tests conducted during the period March–May 1968 are described, the Procurement Specifications and ICC Specifications for the three types of drums in use at SRP are presented. All types of drums (aluminum, stainless steel, and polyethylene) met the requirements on the compression, puncture, and penetration tests. Aluminum drums (straight side and bilge type) were the only ones meeting the requirements on all physical tests conducted. Stainless steel drums met the requirements on the 12-ft drop tests, while the polyethylene drums having an inherent weakness in construction in the top of the drum were the only drums not meeting the requirements of either the 12- or 30-ft drop test. Polyethylene drums were leak-tested at only 2 psig interior air pressure because a similar drum had ruptured at 12 psig hydrostatic test on previous tests in 1964. Aluminum and stainless steel drums met the requirements of the heat test under normal conditions of transport, but the polyethylene drum could meet this requirement only by limiting the pounds of heavy water shipped in each drum to 450 lb. Calculations indicate that requirements on the thermal test under hypothetical accident conditions could not be met. (auth)

30372 (DPSPU-74-124-2) SAFETY ANALYSIS REPORT: PACKAGES, LLD-1 PACKAGE (PACKAGING OF FISSILE AND OTHER RADIOACTIVE MATERIALS). Final Report. Evans, J. E.; Gates, A. A. (comps.). (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Jan 1975. Contract AT(07-2)-1. 98p. Dep. NTIS $8.00.

Plutonium metal buttons are shipped in the LLD-1 package in compliance with AEC Manual Chapter 0529 (AECM 0529), Safety Standards for the Packaging of Fissile and Other Radioactive Materials. (auth)

30373 (K-L-6249(Rev.1)) FISSILE CLASS I SHIPMENT OF URANIUM HEXAFLUORIDE HEEL CYLINDERS. Newlon, C. E.; Taylor, R. G. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 5 Jun 1974. Contract W-7405-eng-26. 7p. Dep. NTIS $4.00.

A nuclear safety analysis was made in 1969 for in-service 5-, 8-, 12-, 30-, and 48-in. cylinders containing small quantities of UF_6 residual, or heel, that remain in the cylinders after normal usage. The current work reflects the change in the safe ^{235}U enrichment from 3.5 to 4.5% for the 48-in. cylinders, and the increase in the maximum heel from 10 to 25 lb for the 30-in. cylinders, which were made since the original study. The evaluation indicates that neither protective packaging nor cylinder spacing is necessary for nuclear criticality safety, and such cylinders meet all safety standards of the U. S. Department of Transportation (DOT) for Fissile Class I radioactive materials shipments. (auth)

30374 (RDT-F-8-11T(1-75)) FUEL SHIPPING CONTAINER TIEDOWN FOR TRUCK TRANSPORT. (USERDA Division of Reactor Research and Development, Washington, D. C.). Jan 1975. 26p. RSO.

This standard describes general requirements, methods of tiedown to conventional trailers for package assemblies having a suitable base, and acceptable size and arrangement of tiedown members for package assemblies up to 25 tons and within certain dimensional limits. Methods of tiedown other than those described are permitted if they comply with the general requirements set forth. (auth)

30375 (SAND-74-5382) QUANTITATIVE ANALYSIS OF TRANSPORTATION ACCIDENT ENVIRONMENTS. Clarke, R. K.; Foley, J. T.; Hartman, W. F.; Larson, D. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 10p. (CONF-750411-2). Dep. NTIS $4.00.

From European nuclear conference; Paris, France (21 Apr 1975).

As the number and size of nuclear material shipments continue to rise at an increasing rate, the probability of transportation accidents which result in release of radioactive material also increases. A statistical and analytical method which has been developed to describe one portion of this risk assessment–the severity of transportation accidents–is reported. This information, used in conjunction with accident rates and container capabilities, can lead to estimates of material release frequencies, and permits current transportation methods, including aircraft, truck, and train, and proposed alterations to these methods to be assessed in a more factual manner. (auth)

30376 (TID/SNA-876) NERVA TRANSPORTATION MODES. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 40p. Dep. NTIS $5.00.

An evaluation is presented of the various methods of transporting an assembled NERVA engine. NERVA engine transportation and handling requirements and constraints were extracted from NPRD, Release No. 7, and engine specification CP 090290A, dated September 8, 1970. Assumptions were made regarding Trade Study 1004 (Engine Acceptance Test Method) and Trade Study 1009 (Poison Wire Removal and Reinsertion on Ground) because these trade studies have not been completed. Environmental accelerations were extracted from S-038 (Dynamic Analysis Report and Handling Shock Data) and applied in accordance with AEC 0529, Safety Standards for Packing of Radioactive and Fissile Materials. These criteria were used to determine the acceleration mitigation and handling shock requirement of an engine shipping container. Shipping container design criteria were found to be independent of transport mode but were, rather, constrained by handling shock. Four methods of engine transport (air, truck, rail, and marine) were analyzed and compared as to route, distance, travel time, personnel support requirements, cost of transporter, and total trip cost. (auth)

30377 TRANSPORTATION OF HAZARDOUS MATERIALS. Hearings Before the Committee on Commerce, United States Senate, Ninety-Third Congress, Second Session, June 12, 13, and 14, 1974. Washington, DC; Committee on Commerce (1974). 438p. GPO.

The June 12, 13, and 14 hearings before the U. S. Senate Committee on Commerce on the transport of hazardous materials, are reported verbatim and are supplemented by additional articles, statements, and letters concerning the air, sea, or land transport of explosives, hazardous chemicals, and radioactive materials. (LCL)

30378 FAA REGULATION CONCERNING HAZARDOUS AIR CARGO. Hearings Before the Special Subcommittee on Investigations of the Committee on Interstate and Foreign Commerce, House of Representatives, Ninety-Third Congress. Second Session on Effectiveness of Procedures and Safeguards re Transportation of Hazardous Materials by Air, April 25 and 30, 1974. Washington, DC; Committee on Interstate and Foreign Commerce (1974). 549p. GPO.

The April 25 and April 30, 1974 hearings before the House of Representatives Special Subcommittee of the Committee on Interstate and Foreign Commerce are presented verbatim. The subject of the hearings was the effectiveness of procedures and safeguards related to the air transport of hazardous materials, including radioactive materials. (LCL)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 31487, 31556, and 32364.

30379 (BNL-19718) HEAVY ION, A > 200, ACCELERATION IN THE AGS. Prelec, K.; van Steenbergen, A. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 10p. (CONF-741152-2). Dep. NTIS $4.00.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

Acceleration in the AGS of ~10^9 heavy ions per sec, with mass number A > 200, to kinetic energies of $1 < T_N < 10$ GeV/nucleon is feasible without modification of basic AGS subsystems by using a (surplus) fast cycling synchrotron as a booster ring. This booster is required in order to obtain the fully stripped ion state, since partially stripped ion acceleration in a slow rise time accelerator is impractical because of extreme vacuum pressure requirements. The fast cycling feature of the booster is essential in reducing transmission losses associated with electron capture or loss during acceleration and beneficial in increasing the exit beam intensity. (auth)

30380 (CONF-750335-2) DESIGN CONSIDERATIONS FOR THE ORNL 25 MV TANDEM ACCELERATOR. Bair, J. K.; Biggerstaff, J. A.; Jones, C. M.; Larson, J. D.; McConnell, J. W.; Milner, W. T.; Ziegler, N. F. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Construction of a 25 MV tandem electrostatic accelerator is now planned as part of a new heavy-ion facility at the Oak Ridge National Laboratory. The design of this accelerator incorporates several unusual features. The most important of these are a folded design, in which the low-energy and high-energy acceleration tubes are contained within a single column structure, and a digital control system. Motivations for these design features are discussed in conjunction with a brief description of the accelerator. (auth)

30381 (CONF-750335-3) INCREASED INTENSITY HEAVY ION BEAMS AT ORIC WITH CRYOPUMPING. Hudson, E. D.; Lord, R. S.; Mallory, M. L.; Mann, J. E.; Martin, J. A.; Smith, W. R. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Previously reported measurements of heavy ion beam attenuation with pressure have demonstrated the need for additional pumping in the circulating beam region of the Oak Ridge Isochronous Cyclotron (ORIC). Two specially designed 20°K cryopumps, located on the magnet poles, have increased the pumping speed in the circulating beam region by about a factor of 3. This has led to increased intensity for beams of heavy ions of elements that can be condensed by the cryopumps (e.g., oxygen, nitrogen, etc.). The improved vacuum has led to an increased understanding of a beam loss in the internal region of the cyclotron. Measured cross sections for beam loss and the cross section energy dependence have been determined. (auth)

30382 (CONF-750335-5) ENERGY BOOSTING OF A TANDEM BEAM WITH THE OAK RIDGE ISOCHRONOUS CYCLOTRON. Lord, R. S.; Ball, J. B.; Hudson, E. D.; Mallory, M. L.; Martin, J. A.; Mosko, S. W.; Beckers, R. M.; Fischer, K. N.; McNeilly, G. S.; Rylander, J. D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 3p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The energy of heavy ion beams from the 25 MV "folded" tandem now being acquired will be increased by additional acceleration in the Oak Ridge Isochronous Cyclotron (ORIC). Beams of ions up to A = 160, with energy sufficient to overcome the Coulomb barrier on lead, will be produced. The beams will enter the cyclotron through the dee stem and be directed by a magnet through the fringe and main fields to a stripping foil which lies on the appropriate orbit for acceleration. A stripping foil holder, an injection magnet, and beam transport elements will be required in addition to modifications of the ORIC rf system. Central ray data for several beams are presented. (auth)

30383 (CONF-750335-6) ISOCHRONOUS CYCLOTRON HARMONIC BEAM EXPERIMENTS. Mallory, M. L.; Hudson, E. D.; Lord, R. S. (Oak Ridge National Lab., Tenn. (USA)). 1975. 3p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

We have previously described a system for boosting the energy of heavy ions in isochronous cyclotrons by recycling. This system requires simultaneous acceleration of two beams on different harmonics, all-magnetic extraction, external separation, and reinjection of the lower energy beam. The first three requirements have now been demonstrated on a limited scale using simultaneous beams from an internal ion source, and without building a reinjection system. A $^6Li^{1+}$ beam on the third harmonic at an energy of 4 MeV and a $^6Li^{3+}$ beam on the fundamental at an energy of 36 MeV were simulanteously accelerated on the Oak Ridge Isochronous Cyclotron (ORIC), extracted and separated, demonstrating the major principles of recycle without closing the loop. (auth)

30384 (CONF-750335-8) PROTON DIAGNOSTIC ACCELERATOR. Martin, R.; Foss, M.; Moenich, J.; Lari, R. (Argonne National Lab., Ill. (USA)). 1975. 4p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The advantage of proton radiography for early cancer detection in soft human tissue has been demonstrated. In order for this technique to become a practical medical tool for early detection of cancer, however, a proton source suitable for use in hospitals and clinics is required. An initial concept of such an accelerator has been discussed. It would meet the requirements considerably better than any existing accelerator and be simple, reliable, and economical. Design parameters are given for the proposed synchrotron. (auth)

30385 (CONF-750335-14) PRODUCTION OF HIGH ENERGY POLARIZED PROTONS. Parker, E. F. (Argonne National Lab., Ill. (USA)). [nd]. Contract W-13-109-Eng-38. 14p. Dep. NTIS $4.00.

The two types of polarized proton ion sources are reviewed, problems in accelerating polarized protons are discussed, and methods for measuring the polarization of polarized proton beams are considered. The program plans for accelerating polarized protons at various accelerator facilities are summarized. (WHK)

30386 (COO-1265-154) ANNUAL REPORT 1974. (Minnesota Univ., Minneapolis (USA). John H. Williams Lab. of Nuclear Physics). Sep 1974. Contract AT(11-1)-1265. 220p. Dep. NTIS $14.00.

Work done during the year ending August 1974 is summarized. Research conducted with the model MP tandem van de Graaff accelerator is described. In addition to the investigation of the structure of a wide range of nuclei (primarily with H and He beams, secondarily with C and O beams), work using x-ray and atomic beam techniques was pursued. Developments of experimental technique and procedure are also reported. Accelerator operation, including the installation of new acceleration tubes and their effects on operating characteristics, is reviewed, along with results of other accelerator modifications. Work of personnel participating in the development of the Clinton P. Anderson Meson Physics Facility is briefly recounted. Individual reports containing significant amounts of information are title listed separately. (RWR)

For title listings of individual papers see: 30403, 30422, 30462, 30823, 30855, 30856, 31333–31337, 31353, 31377–31383, 31401–31403, 31449, 31450, 31492, 31495, 31514, and 31515.

30387 (LBL-3382) ELECTRON RINGS: MEASURED PROPERTIES AND FUTURE APPLICATIONS. Keefe, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1974. Contract W-7405-eng-48. 11p. (CONF-741112-9). Dep. NTIS $4.00.

From 4th all-union national conference on charged particle accelerators; Moscow, USSR (18 Nov 1974).

Extensive measurements on the properties of electron rings and of the limiting nature of collective instabilities have been carried out at Berkeley. Peak collective fields of 5 to 10 MV/m have been regularly achieved; higher values should be attainable by improvement in the quality of the magnetic guide-field. Design parameters for an ion accelerator suitable for biomedical applications are discussed. The design of an electron-ring device to contain ions for the spectroscopic study of atoms in a highly-stripped state is presented. (auth)

30388 (ORNL-tr-2866) LINEAR TRAVELING WAVE ELECTRON ACCELERATOR WITH AN EXIT ENERGY OF 360 MeV. Valyper, A. K.; Grishaev, I. A.; Demyanenko, G. K.; Zykov, A. I.;

Makhnenko, L. A.; Zeytlenok, G. A.; Malyshev, I. F.; Turkin, F. F.; Khokhlov, V. K. 1972. Translated from Russian. (CONF-720952-11). 7p. Dep. NTIS $4.00.

From symposium on collective methods of acceleration, Dubna, USSR (27 Sep 1972).

The layout and design parameters of the 360-MeV linac at Kharkov are presented and discussed. (WHK)

30389 (RISO-M-1765) ACCELERATOR DEPARTMENT ANNUAL PROGRESS REPORT, 1 JANUARY 1974–31 DECEMBER 1974. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1975. 27p. Dep. NTIS (US Sales Only) $4.50.

A description is given of work in the fields of radiation bacteriology research, chemical dosimetry and radiation chemistry, physical dosimetry and irradiation technology, as well as the operation of various irradiation facilities. Appendices include specifications of the irradiation facilities and a list of publications. (auth)

30390 (RL-73-083) PROCEDURE FOR INSTALLATION, ADJUSTMENT, AND REMOVAL OF BEAMLINE COMPONENTS. Stone, R. J. (Science Research Council, Chilton (UK). Rutherford Lab.). Mar 1974. 84p. Dep. NTIS (US Sales Only) $7.25.

Instructions are issued to ensure that inherently safe working conditions exist during the installation, adjustment and removal of NIMROD beam line components. (auth)

30391 (RL-74-131) DESIGN NOTES ON THE TANK AND DEBUNCHER AUTO TUNING SYSTEM FOR THE 70 MeV INJECTOR. Munn, R. W.; Sandels, E. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Dec 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

The report concerns the 70 MeV injector for Nimrod. The auto tuning systems which are described are part of the linac control equipment for maintaining the accelerating field to the correct amplitude and phase. Details are discussed under the following headings: system stability, tank tuners, motor and train gear, motor servo control circuits, phase error circuits, sample and hold amplifier, and system operation with debuncher. (UK)

30392 (RL-74-161) PRELIMINARY NOTE ON DESIGN AXIS GEOMETRY OF THE EPIC e^+e^- STORAGE RING. King, N. M. (Science Research Council, Chilton (UK). Rutherford Lab.). Dec 1974. 56p. Dep. NTIS (US Sales Only) $6.00.

Construction of a machine like EPIC calls for the utmost accuracy in survey and alignment techniques. The main magnetic elements have to be installed within 0.1 mm of the machine's design axis. The preliminary site studies carried out so far referred to a model consisting of four long straight sections separated by four circular arcs. This is only a rough approximation in terms of the survey accuracy required for machine construction. The present note specifies the horizontal design axis of EPIC at the main dipole and quadrupole elements of the latest lattice (Lattice 5) to the required accuracy. A double precision geometry program, EUCLID, has been written to calculate coordinates of these elements; (i) for a cartesian frame with origin at one of the interaction points; and also (ii) for a polar frame related to the geometrical centre of the machine. When a convenient master survey point on the site has been specified, these coordinates can be related to it within EUCLID. (auth)

30393 COMPUTER STUDIES OF COLLECTIVE ION ACCELERATION. Poukey, J.W.; Olson, C.L. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. A 11: No. 2. 691-696 (Feb 1975).

A relativistic electron beam entering a metallic drift tube filled with neutral gas at low pressure (e.g., 0.1–0.5 Torr H_2) creates a potential well which may result in acceleration of ions to several times the beam energy. We have studied this process computationally, with emphasis on the modeling of a number of recent experiments. The code agrees with most of the experimental results, and verifies a recently proposed model for the acceleration process. (auth)

30394 RADIOPROTECTION OF THE SATURNE SYNCHROTRON. Drouet, J.; Leleux, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Protection Contre les Rayonnements). Rayonnements Ionis. Tech. Mes. Prot.; No. 3, 113-126(Jul 1974). (In French).

The synchrotron presents a strong risk of external irradiation. Because of the dose equivalent rates around such an accelerator the equipment must be surrounded by shielding, and safety devices installed to forbid access to the shielded zones during operation. Problems of irradiation due to induced activation demand the sustained vigilance of the Radiation Protection Services in order to limit the dose equivalents received by personnel working on this apparatus. These problems can be overcome to a large extent if the activable parts are designed for easy removal so as to reduce handling times. The various radiation level detectors fitted inside and outside the shielding are listed. Experience of accelerator shielding has proved the convenience and efficiency of centralizing all data concerning radiation levels and safety systems. This is achieved by means of a radiation control panel. (FR)

30395 REGARDING THE SAFETY OF MEDICAL ACCELERATORS. Schittenhelm, R. (Siemens, A. G., Erlangen (F. R. Germany). Unternehmensbereich Medizinische Technik). Strahlentherapie; 148: No. 5, 520-526(Nov 1974). (In German).

From symposium on trends of modern radiotherapy; Vienna, Austria (4 May 1974).

During the last few years, increased numbers of patients and shortage of staff has led to the necessity of introducing automation in radiotherapy, for operation control and supervision–as far as is possible. However, this way out is not entirely free of problems. On the one hand, it is necessary to take into account certain malfunctions of the automation, so that perfection of the automation can lead to an escalation of the costs, and to a decreasing workability of the equipment. On the other hand, it may be dangerous if the operative staff completely relies on the automation, as actually not every irradiation parameter can be automatically supervised. Discussions are still in full swing, as to which parameters should be automatically supervised, and to what degree. By some examples it is explained how to perform the automatic supervision of several very important parameters of the accelerator. Physicians, physicists, technicians, operative staff, legislator and producer will be obliged to cooperate in the near future to find an appropriate solution to this problem, which will also deal with the economic factors involved. (auth)

30396 AUTOMATED ISOTOPE PRODUCTION IN THE AMERSHAM CYCLOTRON. Finlan, M. F. (Radiochemical Centre Ltd., Amersham, Eng.). pp 119-138 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

The Amersham Cyclotron has been developed to produce radioisotopes for periods of up to 160 hours per week, of which ~100 hours of operation is unattended. The factors are described which have contributed to the high rate of utilization; the remotely controlled target system which was designed and made at TRC; the development of the cyclotron, its control systems and protection devices; and mini-computer control. The increased demand for cyclotron produced isotopes and for the highest radionuclidic purity have led to the development of techniques for the irradiation of separated stable isotopes for the production of many isotopes in the internal beam of the Amersham Cyclotron. One such is ^{111}In, which is now produced routinely with an ^{114m}In level of ~0.01% at the end of the irradiation. This isotope promises to complement ^{99m}Tc for diagnostic work. (auth)

30397 GREEK TANDEM VAN de GRAAFF ACCELERATOR. Katsanos, A. (Greek Atomic Energy Commission, Athens). pp 139-140 of Radioisotope Production. Athens; Greek Atomic Energy Commission (1974).

From 5th European meeting on radioisotope producers; Athens, Greece (27 Nov 1974). See CONF-741147-.

The design parameters of the T $^{11}/_{25}$ Van de Graaff accelerator are given, and its use for radioisotope production is briefly discussed. (WHK)

30398 PRODUCTION OF SHORT-LIVED RADIONUCLIDES IN CYCLOTRON AND CLINICAL APPLICATIONS. Arimizu, N. (National Inst. of Radiological Sciences, Chiba (Japan)). Gendai No Shinryo.; 16: No. 5, 725-733(May 1974). (In Japanese).

This report describes the significance of short-lived radionuclides produced in a cyclotron and their clinical applications (i.e., scintigram, function tests of various organs, measurement of body fluid, measurement of blood flow etc.). Procedures for obtaining half lives and properties and the medical application of the main short-lived radionuclides produced by cyclotrons are mentioned. Furthermore, the sort of radionuclides which can be produced by small medical cyclotrons and their economics are discussed. It is concluded that there may be advantages in providing medical cyclotrons in Japan. In addition, the significance of positron scintigraphy and its use are stated, because many cyclotron-produced radionuclides emit positrons. (JA)

30399 INTERACTION BETWEEN COHERENT LIGHT WAVES AND FREE ELECTRONS WITH A REFLECTION GRATING Mizuno, K.; Ono, S.; Shimoe, O. (Tohoku Univ., Sendai). Nature (London); 253: No. 5488, 184-185(17 Jan 1975).

It has been demonstrated that light is emitted when a high voltage electron beam moves parallel and close to a metallic optical diffraction grating in a direction perpendicular to the grating

rulings. This radiation has been explained physically in terms of the oscillations of the charge induced on the grating by electrons in the beam. The "inverse Smith–Purcell effect" is considered with a view to obtaining extended interaction of an electron beam moving along the grating surface with light incident on the surface. When a synchronous condition is satisfied effective interaction must occur between the electron beam and the light wave in the same manner as the spacial harmonic interaction occurring in microwave travelling wave tubes, lending to acceleration or deceleration, according to the conditions. If the electron undergoes net acceleration over a period of time then electromagnetic field energy is converted into electron kinetic energy, giving an optical electron accelerator. Such laser accelerators will have the property of providing high acceleration gradients because of the intense fields that can be obtained, and an acceleration of the order of 1 GeV/m may be anticipated. Current pulses of time duration of the order of 10^{-15} sec may also be produced, useful for studying ultra-fast relaxation processes. Under other conditions light amplification may be obtained. It should be possible to miniaturize linacs by application of the "inverse Smith–Purcell" effect here described. (UK)

Auxiliaries and Components

30400 (AED-CONF-74-089-054, pp C1-C12) OPERATING EXPERIENCE GAINED WITH THE FIRST CRYOSTAT OF THE SUPERCONDUCTING LINEAR ACCELERATOR AT A 300 WATT 1.8 K REFRIGERATOR PLANT. Lehmann, W. Apr 1974. (In German).

From spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F.R. Germany (1 Apr 1974).

With abstract in German and English.

In testing and operation of helium refrigerators for applied superconductivity.

In a prototype of a superconducting rf linear accelerator protons were accelerated with accelerator field strengths of 1.2 MV/m. The cooling circuit designed for this purpose with the first He II cryostat at a 300 W, 1.8 K refrigerator plant has been operated experimentally for 2,000 hours. The operation data obtained for the cryostat in cryogenics and vacuum engineering are in agreement with specifications and allow reliable use of the acceleration section. Following a short description of the cryostat, the method of cooling and the instrumentation of the cryostat, long-term experience is reported which has been gathered with this cooling circuit. Finally, the planned extension of the cryostat system is mentioned. (auth)

30401 (CONF-690354-) JOINT VACUUM MEETING, BASEL, SWITZERLAND, 27–28 MARCH 1969. (Basel Univ. (Switzerland). Physikalisches Inst.). 1969. 87p. (In German).

Summaries are compiled of the papers presented. The first session of the conference was devoted to vacuum separation methods. The second session was concerned with vacuum problems in particle accelerators, pumps for obtaining very high vacuums, ultra-high vacuum techniques, radiation damage to sealants in particle accelerators, vacuum scattering chambers for particle studies, and vacuum systems for various particle accelerators. (JSR)

30402 (CONF-750335-15) INEXPENSIVE PULSED POWER SUPPLY FOR A SEPTUM MAGNET. Praeg, W. F. (Argonne National Lab., Ill. (USA)). [nd]. Contract W-13-109-Eng-38. 5p. Dep. NTIS $4.00.

A 16 μH, 6 mΩ septum magnet load must be pulsed while extracting the beam from the 200-MeV booster of the Zero Gradient Synchrotron (ZGS). A power supply was designed for this purpose that can deliver ~2 ms wide, half sine wave pulses with a PRF of 30 pulses per second. The peak current is adjustable from 3 kA to 10 kA and repeatable within ±0.05% by means of a novel charging circuit. By providing a transformer between the magnet and the capacitor bank, the overall cost of the system was reduced to less than one half of that of a conventional capacitor discharge system. A high-Q choke shunts the negative half wave of the current around the transformer, thereby extending the life expectancy of the magnet and increasing the circuit efficiency. (auth)

30403 (COO-1265-154, pp 186; 190-191) DEVELOPMENT OF NEW COLUMN RESISTORS. Blair, J. M.; Broadhurst, J. H.; Hepplemann, S. Sep 1974.

In annual report 1974.

30404 (JINR-P9-8317) PROBLEMS OF CONSTRUCTION OF SUPERCONDUCTING ACCELERATING SECTION FOR HEAVY ION ACCELERATOR. Derendyaev, Yu. S.; Zinov'eva, L. L.; Iovnovich, M. L.; Kuznetsov, A. B.; Preizendorf, V. A.; Rubin, N. B.; Smirnov, Yu. I.; Shabratov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1974. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A superconducting accelerating section for a heavy ion accelerator is considered. The physical basis of the section parameters is given. The problems of joining the superconducting section with the dynamic solenoid are considered. (auth)

30405 (LA-UR-75-372) INCREASING THE RELEVANCE OF DATA PRESENTED TO THE OPERATORS IN AN ACCELERATOR CONTROL SYSTEM. Swain, G. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750335-16). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Relevancy assumes a critical importance in control system operation because of the large amount of information available. The information deluge impacts the following areas: If information is presented at too high a rate or in too large blocks, the operators may not comprehend it. If useless data is often presented in a given display, the operators may ignore all data presented by that display. If the context of the data is not presented, the data may be meaningless to the operators. If the control and display systems are not properly designed, peaks in the message generation rate may choke the system. This paper describes the techniques in use and under development at the Clinton P. Anderson Meson Physics Facility for increasing the relevance of data both for real-time operations and for long-term analysis of accelerator performance. Data sifting and organization for presentation and for compact storage is discussed. (auth)

30406 (LBL-3372) DESIGN OF THE CRYOPUMPING VACUUM SYSTEM FOR ESCAR. Wolgast, R. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-ENG-48. 5p. (CONF-750335-18). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

ESCAR is an experimental superconducting accelerating and storage ring for protons. Scattering collisions with residual gas degrades the quality of proton beams that are stored for long time periods. The loss of quality will be small if the average gas density in the path of the beam is kept less than about 10^6 molecules per cm^3, depending upon the gas species. This density corresponds to a room temperature pressure for nitrogen-like gases of 3×10^{-11} Torr. It is planned to achieve this vacuum goal in the ESCAR ring by distributed cryopumping at 4.5°K, the operating temperature of the superconducting magnets. In the magnet sections the cold bore of the magnet will provide the condensing surface. In the straight sections, 4.5°K beam tube or distributed cryopumps will be provided consistent with the function of the particular section. The large cryosurface area provides effective pumping capacity for H_2 by utilizing sub-monolayer adsorption. The surfaces can be degassed of H_2 by a temperature rise to 15°K. The cycle can be accomplished during routine maintenance periods. The interval between the degassing of the magnet quadrants is expected to be of the order of months. Because of the experimental nature of ESCAR, sector valves will be provided to permit the isolation of each straight section from the ring to allow ready accessibility for equipment testing and modification. Each section will have a roughing and conditioning pumping station. It is planned to use valved, bare surface cryopumps, augmented by cryosorption on CO_2, to finish roughing and for pumping during the H_2 degas cycles. (auth)

30407 (ORNL-tr-2900) BIM EXPERIMENT, FEBRUARY 16, 1969. Neel, J. 5 Mar 1969. Translation by Martha Gerrard, Oak Ridge National Lab., Tennessee, of JN/SEDAP/69-69 SUP/22 NT. 8p.

Performance testing with the BIM coil is described and an impedance value to 1365 A was observed. (MCW)

30408 (RL-74-142) INVESTIGATION INTO THE USE OF THYRISTORS IN PLACE OF THE PRESENT MERCURY-ARC CONVERTERS IN THE EXCITATION EQUIPMENT OF THE ALTERNATORS OF THE NIMROD MAGNET POWER SUPPLY PLANT. Packer, T. J. (Science Research Council, Chilton (UK). Rutherford Lab.). Sep 1974. 36p. Dep. NTIS (US Sales Only) $5.00.

The report describes the design and prototype testing of thyristor equipment in the above application following the announcement by the manufacturers that the reconditioning service for mercury-arc converters would cease at the end of 1973. The results show that the use of thyristors is quite feasible with only minor modifications to the existing equipment. (auth)

30409 (RL-74-160) 70 MeV INJECTOR: EARTH BONDING IN THE EHT AREA. Wheldon, A. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Dec 1974. 6p. Dep. NTIS (US Sales Only) $4.00.

A brief description is given of the methods used to provide

earth bonding within the EHT area of the new 70 MeV injector for NIMROD together with a record of the results obtained during first testing of the installation. (auth)

30410 A SUPERCONDUCTIVE WINDING AND METHOD FOR MANUFACTURING SAME. Moisson-Franckhauser, F. (to Compagnie Generale d'Electricite (CGE), 75 - Paris (France)). French Patent 2,181,135/D/. 18 Apr 1972. 10p. (In French).

A superconductive winding is described, in which the thermal contact between said winding and a cryogenic fluid is obtained through a transposed thermal conductor located between said fluid and each turn of the first layer of said winding; this conductor is partly embedded in the synthetic resin impregnating said winding and is sectional longitudinally. The method comprises impregnating the winding turns with synthetic resin and machining in order to allow the transposed conductor to be longitudinally sectioned. (FR)

30411 AN ELECTROMAGNET FOR BETATRONS. Chakhlov, V. L.; Zvontsov, A. A.; Filimonov, A. A. (to Tomskij Politekhnicheskij Inst. (USSR)). French Patent 2,188,398/A/. 12 Jun 1972. 10p. (In French).

An electromagnet for a betatron is described. It consists of a magnetic circuit with poles which limit the working zone in which the betatron vacuum chamber is placed and an excitation winding. The electromagnet is characterized in that each pole of the electromagnet has a solid central part and at least three radial fins on the central part. These fins do not emerge from the limits of the working zone. (FR)

30412 OPERATIONAL MEASUREMENT OF BIOMEDICAL PROTON BEAM INTENSITY. Kleinbok, Ya. L.; Narinskii, V. M. Sov. At. Energy (Engl. Transl.); 37: No. 1, 751-753(Jul 1974).

Translated from At. Energ.; 37: No. 1, 69-70(Jul 1974).

A beam of protons with energies from 70 to 200 MeV has been used at the Institute of Theoretical and Experimental Physics for biological studies and for radiation therapy of cancers. The pulse duration of the extracted proton beam is 1.6 μsec, the repetition rate 0.25 Hz, the intensity range $2 \times (10^8$ to $10^{11})$ protons/pulse; the transverse dimension of the beam varies from 3 to 90 mm, and the energy range is 70 to 200 MeV. The performance of biological studies required the creation of an operational system providing measurement of intensity in practically single beam pulses (reciprocal duty factor, 25×10^5) under conditions of strong electromagnetic interference produced by the proton extraction system at the very time of measurement. The use of an electromagnetic sensor is described which made it possible to create an interference-proof system for operational measurement of the intensity of the biomedical proton beam using comparatively simple equipment. (WHK)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 30385.

30413 (CONF-750303-27) ROTATABLE COLD CATHODE PENNING ION SOURCE. Mallory, M. L.; Hudson, E. D. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A rotatable cold cathode Penning ion source has been designed and is now operating in the Oak Ridge Isochronous Cyclotron (ORIC). Previous sources for positive heavy ions have been severely limited in life-time by cathode sputtering and buildup of sputtered cathode material. The new ion source extends the cathode lifetime by a factor of ~6. The source cathodes are discs of tantalum, $\frac{7}{8}$ in. in diameter and $\frac{1}{8}$ in. thick. Upon completion of an ion source "burn" at one position on the circular edge of the cathode discs, each disc is rotated to an unused position for the next "burn." Provision exists for continuous rotation of the cathodes. The plasma collimating holes, where the sputtered cathode tantalum is deposited, also are on discs with six possible positions. The new source has resulted in increased accelerated beam currents and greater stability for heavy ions. The source has also been used to produce light ion beams (H, D, α) over a wide range of intensities. (auth)

30414 (CONF-750335-4) ONE TURN VERTICAL EXTRACTION FROM THE ZERO GRADIENT SYNCHROTRON (ZGS). Kustom, R. L. (Argonne National Lab., Ill. (USA)). 1975. 4p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

A proposal exists to add a superconducting beam stretcher ring (SSR) to the ZGS in order to improve the duty cycle of the extracted beam. One turn extraction from the ZGS is required to efficiently load the stretcher ring. The large height and width of the ZGS magnet gap make it difficult to develop a sufficiently large deflection field in between ZGS bunches, a period of about 55 ns, for radial extraction with ferrite kicker magnets. However, an electromagnetic deflection can be developed in the vertical direction using an unloaded strip line. Since the midplane of the SSR is to be above the median plane of the ZGS, vertical extraction imposes no special problems as far as injection into the SSR is concerned. The transmission line system described will be capable of extracting the beam from the ZGS in one turn. The beam will be exiting in the vertical direction, which will be compatible with injection into the SSR. The bunch dimensions and phase space parameters are matched between the two machines so that very nearly 100% transfer is expected. (WHK)

30415 (CONF-750335-13) OPERATING RESULTS AND IMPROVEMENTS ON THE ZERO GRADIENT SYNCHROTRON (ZGS) POLARIZED PROTON ION SOURCE. Parker, E. F.; Sesol, N. Q.; Timm, R. E. (Argonne National Lab., Ill. (USA)). [nd]. Contract W-13-109-Eng-38. 7p. Dep. NTIS $4.00.

The ANL polarized proton ion source has been operating for almost two years. In that time, the improvements and modifications discussed here have increased the peak current by a factor of 3 and the polarization to 75 to 80%. The beam stability and spin reversal are no longer problems, and the maintenance requirements have been significantly reduced. Some further increases in the output current of the source may be possible. Adding up all of the current gains discussed above and applying them to a well-tuned source with a clean, efficient dissociator tube; beam currents of 50–60 μA may be possible. A new rf amplifier and a higher voltage electron gun in the ionizer may allow currents in the 75 μA range. However, beam currents beyond this level will probably require a radically new approach to the design of atomic beam sources. (auth)

Ion Optics and Field Calculations

30416 MECHANICAL ANALOG OF THE SYNCHROTRON, ILLUSTRATING PHASE STABILITY AND TWO–DIMENSIONAL FOCUSING. Alvarez, L.W.; Smits, R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Senecal, G. Am. J. Phys. 43: No. 4, 293-296 (Apr 1975).

A steel ball bounces in synchronism with a vertically oscillating piston. The piston surface is a hardened steel disk on which the ball bounces; two–dimensional horizontal focusing is provided by the concavity of the surface. The period of oscillation can be varied over a 3:1 range with the amplitude kept constant. As the period is increased, the ball bounces higher. As the period is decreased, the ball bounces lower, contrary to the intuition of most observers. The model illustrates the important properties of synchrotron accelerators. (auth)

Storage Rings

Refer also to abstract 30414.

30417 (BNL-19719) NATURE OF THE BEAM–BEAM LIMIT IN STORAGE RINGS. Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 6p. (CONF-750335-9). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The experimental results relating to the beam–beam interaction in electron storage rings and the ISR (p-p collisions) are considered. The question of whether or not stochasticity is implied by these results is discussed. It is argued that all the available evidence on the beam–beam limit is not inconsistent within an isolated resonance framework. A model which qualitatively fits the observations, one which is derived from classical resonance theory, is proposed. (auth)

30418 (LBL-3078) ESCAR: FIRST SUPERCONDUCTING SYNCHROTRON, STORAGE RING. Elioff, T.; Gilbert, W. S.; Lambertson, G. R.; Meuser, R. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-eng-48. 4p. (CONF-740981-1). Dep. NTIS $4.00.

From applied superconducting conference; Chicago, Illinois USA (30 Sep 1974).

The Experimental Superconducting Accelerator Ring (ESCAR) project is an accelerator technology development for which the primary goal is to obtain design and operational experience with a complete accelerator and storage ring system utilizing superconducting magnets. Full scale design effort began in July 1974,

and operation is planned in 1977. The design parameters are listed; and the superconducting magnets and cryostats and the vacuum system are described. (WHK)

30419 (RL-74-145(Rev.1)) EPIC TRANSFER LINES: PRELIMINARY BEAM DESIGN. Jones, B. D. (Science Research Council, Chilton (UK). Rutherford Lab.). Sep 1974. 6p. (EPIC/MC-36(Rev.1)). Dep. NTIS (US Sales Only) $4.00.

The design described in an earlier report (RL-74-015) have been modified to take account of changed accelerator parameters and have been extended to include linac-booster transfer lines; in the present report, however, the transfer of protons is not considered. As before, it has been considered desirable to use existing beam-line components and power supplies where possible in the designs; the matching program TRANSPORT was used in the optimizations, which were to first order. (auth)

30420 INFLUENCE OF THE SELF–ACCELERATION EFFECT ON THE PHASE SPAN OF A RELATIVISTIC ELECTRON BUNCH IN A STORAGE RING. Koba, I.I.; Kononenko, S.G.; Lobzov, L.D.; Mocheshnikov, N.I.; Naugol'nyĭ, N.N. (Physico–technical Institute, Ukrainian Academy of Sciences). JETP Lett. 20: No. 9, 278-279 (5 Nov 1974).

We investigate the influence of self–acceleration on the phase span of a relativistic electron bunch in a storage ring. The experimental data are compared with the theory. (auth)

Experimental Facilities

Refer also to abstracts 29666, 29715, and 29725.

30421 (CONF-750335-10) OPERATION OF ARGONNE NATIONAL LABORATORY'S rf PARTICLE SEPARATOR IN THE TRAVELLING WAVE MODE. Moretti, A.; Schultz, P. F. (Argonne National Lab., Ill. (USA)). 1975. 4p. Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Argonne's rf deflector separated beam line has been operated in the traveling wave mode. It has produced a good yield 50% pure $\bar{p}$ beam at 4.08 GeV/c. The operating frequency is lowered to make the phase velocity of the rf separator synchronous with the wanted particle. Results for $\bar{p}$ beams at 2.57, 4.08 and 5.77 GeV/c are presented. In addition, the operation of the traveling wave separator in the "non-conventional" manner, i.e., phase velocity synchronous with unwanted particle, is described. (auth)

30422 (COO-1265-154, pp 171-174) OPTIMIZATION OF THE RESOLUTION OF THE ENGE SPLIT-POLE SPECTROMETER FOR HEAVY-ION INDUCED REACTIONS. Heppelmann, S.; Dehnhard, D.; Broadhurst, J. H. Sep 1974.

In annual report 1974.

30423 (EFI-21-73) POSSIBILITY TO OBTAIN HIGHLY MONOCHROMATIC AND POLARIZED PHOTONS. Alikhanyan, A. I.; Avakyan, R. O.; Bayatyan, G. L. (Erevanskij Fizicheskij Inst. (USSR)). 1973. 7p. INIS.

A method is proposed for obtaining highly monochromatic and polarized γ quanta by aiming the bremsstrahlung photons of high energy electrons on diamond crystals. A polarization of 90% can be obtained with a monochromaticity of $\Delta E_\gamma / E_\gamma = 2$ to 3%. The method can be used both on electron accelerators and on the electron beam from a proton accelerator. (tr-auth)

30424 (GEPP-133) AUTOMATIC PROCESSING OF A GLASS MICROBALLOON FILLED RESIN SYSTEM. Gillespie, T. J. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 22 Jan 1975. Contract AT(29-2)-656. 24p. Dep. NTIS $4.25.

Encapsulation of neutron generators fabricated at GEND is described. Standard manual encapsulation methods do not work well with a resin system in which glass microballoons are used as filler. The system sustains balloon breakage and loses heat rapidly, producing flow problems and surface voids. These problems are overcome with automatic processing equipment described in this paper. With this equipment, the filled resin and curing agent are mixed in a static mixer. Material flow is achieved using Moyno and Zenith pumps and diaphragm valves to balance flow pressures. All controls are automatic. Tests results show a significantly higher tensile strength in the resin prepared with the automatic processor and a significant decrease in broken microballoons. (auth)

30425 (LA-UR-75-373) PERFORMANCE OF THE HIGH-ENERGY PION BEAM AT LAMPF. Werbeck, R. D.; Macek, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750335-17). Dep. NTIS $4.00.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The Los Alamos Clinton P. Anderson Meson Physics Facility (LAMPF) high-energy pion beam (P^3) is a three-bend channel with two achromatic output legs designed for high-intensity and moderate resolution. The best resolution was measured to be 0.2% in $\Delta p/p$. A phase space of about 25 π mr-cm is transmitted by the channel. A π^+ flux of 2×10^7 pions/s was measured for 300 MeV/c momentum when a 7 μA proton beam struck a 6 cm graphite target. Proton contamination for good quality π^+ beams up to 450 MeV is negligible when an energy degrader (graphite) is used to separate protons from pions. In actual operation, very little beam tuning is required. Focusing elements are set according to the TRANSPORT computer code. Additional rate and contamination data are presented, as well as additional information gained from operating experience. (auth)

30426 NEPTUNE. Donnadille, B. (Compagnie Generale de Radiologie, 75 - Paris (France)). pp 131-134 of 3. Colloquium on Non-Destructive Testing Methods, 14-16 May 1974. Issy-les-Moulineaux, France; Compagnie Generale de Radiologie ([nd]). (In French).

From 3rd colloquium on non-destructive testing methods; Toulouse, France (14 May 1974).

Neptune is a linear electron accelerator providing x rays by electron bremsstrahlung in a heavy metal target. Two types of apparatus exist: Neptune 6 which delivers 750 R/min at 1 m for a mean energy of 5.5 MeV, and Neptune delivering 2000 R/min at 1 m for a mean energy of 10 MeV. The performances of these instruments are given. (FR)

30427 RAPID TREATMENT FIELD LIGHT ADJUSTMENT FOR LINEAR ACCELERATORS. Lane, R. G. (Univ. of Wisconsin, Madison). Radiology; 114: No. 3, 736(Mar 1975).

A technique for rapid, accurate alignment of the light field to the radiation field is presented. When these two fields are coincident, a permanent template results which minimizes machine down time when this procedure is required during the treatment day. (auth)

30428 EXPERIMENTAL EVALUATION OF THE SCATTER OF 14.8 MeV NEUTRONS FROM A STEEL COLLIMATOR. Jones, K. M. Madison, WI; Univ. of Wisconsin (1974). 130p. University Microfilms Order No. 74-24,730.

Thesis (Ph. D.).

A 52.5 cm. long steel collimator for 15 MeV neutron therapy beams has been evaluated in terms of the distribution of the collimator-scattered neutrons in the field and penumbra, the distribution in the collimator of the neutron scattering sites, and the energy of the neutrons scattered to one position in the penumbra. The benefit in terms of reduced penumbra and increased beam energy to be gained by reducing the scatter with a second taper on the source end of the collimator was determined. (WHK)

30429 EXCHANGE OF THE TRITIUM TARGET AND CLEANING OF THE ROTARY TARGET MOUNTING AND MOTOR IN THE NA-2 NEUTRON GENERATOR. Tomaskova, L.; Hendlinger, E. (Laborator Radiologicke Dozimetrie CSAV, Prague). Radioisotopy; 16: No. 1, 115-121(1975). (In Czech).

The exchange of the tritium target and cleaning of the rotary target mounting of the NA-2 neutron generator may lead, when the prescribed safety precautions are not strictly obeyed, to contamination of workers, equipment and rooms. A working procedure is described which was employed in the Laboratory of Radiological Dosimetry of the Czechoslovak Academy of Sciences and which ensures minimum potential risk for the personnel and minimum contamination of the generator environment with tritium. (auth)

30430 NEUTRON GENERATOR AND ITS USE IN THE LABORATORY OF RADIOLOGICAL DOSIMETRY OF THE CZECHOSLOVAK ACADEMY OF SCIENCES. Tomaskova, L.; Hendlinger, E. (Laborator Radiologicke Dozimetrie CSAV, Prague). Radioisotopy; 15: No. 4, 607-616(1974). (In Czech).

The main applications of the neutron generator NA-2 in the LRD of the Czechoslovak Academy of Sciences are briefly summarized and the fundamental problems of work with long term bombardment with 14-MeV neutrons are outlined. (auth)

30431 NEW INSTRUMENTAL MEANS FOR THE MEDICAL APPLICATION OF HIGH-ENERGY PARTICLES. Fiorini, E. (Univ., Milan). G. Fis. Sanit. Prot. Radiaz.; 18: No. 4, 151-173(1974). (In Italian).

The existence of high energy and high intensity particle accelerators, which are normally used in elementary particle and nuclear physics, make it possible to study nonconventional radiations in view of their biological effects and possible applications to radiotherapy and diagnostics. In the present paper, beams of protons, heavy ions, neutrons and π mesons are discussed. We

are in particular concerned with the possibility of concentrating the dose in depth with little damage to surrounding tissues, with energy loss in tissues in connection with biological effects, with outside monitoring of the topological concentration of radiation. Some consideration on possible diagnostics with proton and muon beams conclude the paper. (auth)

30432 SYNCHROTRON RADIATION: A NATIONAL FACILITY. Lynch, M. J. (WAIT, Nedlands, Australia). Aust. Phys.; 12: No. 2, 19-22(Feb 1975).

The advantages and disadvantages of synchrotron radiation for applications in research work are described. It is argued that Australia should have a synchrotron facility. (AT)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 30598 and 30908.

30433 (CEA-N-1738) CREATION OF DEUTERONS AND ^{3}He IN THE INTERSTELLAR PROPAGATION OF COSMIC RADIATION. Meyer, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Electronique Physique). Jun 1974. 250p. (In French). Dep. NTIS (US Sales Only) $15.50.

Thesis. Submitted to Paris Univ., Orsay (France).

The formation of deuterons and ^{3}He in galactic cosmic rays by spallation reactions between cosmic-ray nuclei (p, ^{4}He, C, N, O) and interstellar matter is discussed. This study comprises a brief discussion of the possible sources of cosmic-ray nuclei and of their mode of propagation and confinement in the Galaxy, and a detailed study of the relevant cross sections (mainly p–^{4}He spallation). The d/^{4}He and ^{3}He/^{4}He ratios in interstellar space thus calculated for various models of sources and galactic propagation are then compared with the observations taken close to Earth, with consideration to the modulation of the galactic fluxes in the interplanetary medium due to the inhomogeneous magnetic fields carried away by the solar wind. Conclusions are drawn on the source properties, the conditions of propagation in the Galaxy and on solar modulation, and new observations are suggested. (FR)

30434 (LUIP-CR-74-04) EFFECT OF SIMULTANEOUS ACCELERATION AND FRAGMENTATION ON THE COMPOSITION OF THE IRON GROUP OF LOW ENERGY COSMIC RAYS. Lindstam, S. (Lund Univ. (Sweden). Fysiska Institutionen). May 1974. 49p. Dep. NTIS (US Sales Only) $5.50.

The effect of simultaneous acceleration and fragmentation on the charge composition of the iron group $21 \leq Z \leq 26$ is investigated. A pure ^{56}Fe source is assumed and several acceleration mechanisms and potential path length distributions are applied. The iron particles are injected at 40 MeV/N and accelerated to 300 and 1000 MeV/N. It is found that the ratio $N(21 \leq Z \leq 25)/N(Fe)$ depends only weakly on the energy at which matter is traversed. It is, however, a good measure of the amount of matter traversed. The ratio N(Ti)/N(Cr) depends on the acceleration mechanism to a degree which makes it possible to distinguish between different acceleration mechanisms from measurements. (auth)

30435 (LUIP-CR-74-05) ABUNDANCE OF NUCLEI FROM FLUORINE TO SULPHUR IN COSMIC RAYS. Andersson, R. (Lung Univ. (Sweden). Fysiska Institutionen). May 1974. 52p. Dep. NTIS (US Sales Only) $5.75.

The expected charge spectrum at the top of the atmosphere has been calculated for the charge interval $9 \leq Z \leq 16$. The calculations have started with a source composition similar to that of the solar system and with a selection mechanism that depends on the cross-section for ionization of neutral atoms by electron impacts. The particles in the source region have been accelerated to their final energy either momentarily or slowly with simultaneous spallation processes. The particle propagation in interstellar space is described either by a slab model or by models with exponentially distributed path lengths. The ratios F/Ne, Na/Mg, Al/Si, (Na + Al)/(Mg + Si), and P/S have been calculated as a function of the amount of matter passed for the different transport models and compared with the experimental results. If the transport takes place at the constant energy E = 800 MeV/N, the comparisons indicate a path length of about 4 g cm^{-2} for the slab model and a mean path length of about 5 g cm^{-2} for the exponential model. The possibilities of using ^{26}Al to determine the age of the cosmic rays have been studied. The ratio Na/Al was found to be very advantageous for an age determination but experimental data are not yet of sufficient quality for this age estimate. (auth)

30436 (LUIP-CR-74-08) ABUNDANCE OF NUCLEI FROM SODIUM TO SILICON IN COSMIC RAYS. Andersson, R. (Lund Univ. (Sweden). Fysiska Institutionen). Sep 1974. 28p. Dep. NTIS (US Sales Only) $4.50.

The expected charge spectrum at the top of the atmosphere has been calculated for the charge interval $11 \leq Z \leq 14$. The calculations have been based on the assumption that cosmic-ray particles are selected by an ionization process from matter having "normal" composition. The ratios Na/Mg, Al/Si, and (Na + Al)/(Mg + Si) have been studied as a function of the amount of matter passed for different transport models and compared with experimental results. If the transport takes place at the constant energy E = 800 MeV/N, the comparisons indicate a path length of about 4 g cm^{-2} for a slab model and a mean path length larger than or equal to 5 g cm^{-2} for an exponential model. The possibilities of using ^{26}Al to determine the age of cosmic rays have been discussed. The ratio Na/Al is found to be very advantageous for an age determination but experimental data are not yet sufficiently accurate for this age estimate. (auth)

30437 (LUIP-CR-74-09) ENERGY DISTRIBUTION OF VERY HEAVY COSMIC RAY NUCLEI WITHIN THE PENUMBRA AT PALESTINE, TEXAS. Mathiesen, O.; Larsson, L.; Andersson, R. (Lund Univ. (Sweden). Fysiska Institutionen). Sep 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

The low-energy of the rigidity spectrum of cosmic-ray nuclei with atomic numbers $Z \geq 18$, recorded in a balloon flight conducted from Palestine, Texas, was compared with a corresponding theoretical spectrum based on the computations by Shea and Smart. The two distributions were found to be in qualitative agreement with each other. The spread in apparent particle charge, caused by the theoretical distribution of particle velocity at Palestine, was calculated for detectors with different response functions. The resulting structure of the predicted charge spectrum of iron group nuclei was found to be in good agreement with corresponding experimental data. (auth)

30438 (LUIP-CR-74-13) WIDTH MEASUREMENTS ON SHORT TRACKS OF COSMIC RAY NUCLEI IN NUCLEAR EMULSION. Joensson, G. (Lund Univ. (Sweden). Fysiska Institutionen). Oct 1974. 28p. Dep. NTIS (US Sales Only) $4.50.

Width measurements were made on tracks of 100 stopping particles of known nuclear charges $Z = 5$ to 26 in G5-emulsion in the residual range interval $0 \leq R \leq 400$ μm. The widths were measured with a filar micrometer according to a special pattern of measurement. The mean track widths in microns were calculated as a function of residual range and nuclear charge. A comparison was made between measured and theoretical track widths. The charge resolution of the measuring technique was estimated. Within the charge groups 5 to 8, 10 to 14, and 24 to 26 the standard deviation of the charge determination amounted to 0.4, 0.8, and 1.8 units of charge respectively when the measurements were made on the last 100 μm residual range and a straightforward sum of the measured widths was used as the charge parameter. (auth)

30439 (RL-74-156) DO EXTENSIVE AIR SHOWER DATA PROVIDE A RELIABLE INFORMATION ON PROTON–PROTON TOTAL CROSS SECTION? Formanek, J.; Franek, B. (Science Research Council, Chilton (UK). Rutherford Lab.). Dec 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

Zenith angle dependence of frequencies of extensive air showers is discussed from a point of view of nucleon–nucleon total cross section. It is shown that this kind of data cannot, without additional assumptions, distinguish between asymptotically constant cross section and that increasing as ln s or even as $(\ln s)^2$. (auth)

30440 CROSS CORRELATION BETWEEN COSMIC–RAY FLUCTUATIONS AND INTERPLANETARY MAGNETIC–FIELD FLUCTUATIONS. Jokipii, J.R.; Owens, A.J. (Department of Planetary Sciences, University of Arizona, Tucson, Arizona 85721). Geophys. Res. Lett. 1: No. 8, 329-332 (Dec 1974).

We present a study of the cross correlation between cosmic–ray intensity fluctuations and the interplanetary magnetic field, using the low–frequency limit of the theory of the interplanetary scintillations of cosmic rays. Cross–spectral analysis of the flux of the Alert neutron monitor and simultaneous values of the interplanetary magnetic field components are presented which support the theory. A model of cosmic–ray fluctuations is described, with effects of gradients and interplanetary sector structure dominating for very low frequencies ($f \lesssim 5 \times 10^{-6}$ Hz) and magnetic–field induced interplanetary scintillations of cosmic rays dominating for higher frequencies. (auth)

30441 ON A NONLINEAR CLOSURE APPROXIMATION FOR COSMIC–RAY DIFFUSION EQUATIONS. Lerche, I. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois). Astrophys. J. 195: No. 3, 783-784 (1 Feb 1975).

Owens has recently proposed, and used, a nonlinear closure approximation for the turbulent Liouville equation in order to obtain a cosmic–ray diffusion equation. We show here that his proposed scheme is forbidden since it demands that a positive definite integral be identically zero. (auth)

30442 ON THE NONLINEAR CLOSURE APPROXIMATION FOR COSMIC–RAY DIFFUSION. Owens, A.J. (Department of Physics, Lake Forest College). Astrophys. J. 195: No. 3, 785-786 (1 Feb 1975).

Lerche has recently claimed that the nonlinear closure approximation is invalid. His discussion reemphasizes the approximate nature of the

model, but gives no indication of its accuracy. His initial equations involve higher-order terms than those retained in the approximation, and hence do not bear on it. His subsequent comments concerning number and energy density fluctuations are shown to apply to Dupree's nonlinear model as well. His conclusions depend critically on α_0 being strictly independent of velocity, which previous discussions have shown is not necessary. (auth)

30443 MONTE CARLO CALCULATIONS OF NUCLEAR CASCADES AND ASSOCIATED ČERENKOV RADIATION IN EXTENSIVE AIR SHOWERS. Grindlay, J.E. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138). Phys. Rev. D 11: No. 3, 517-522 (1 Feb 1975).

We present a Monte Carlo calculation, with observed cross sections and multiplicities, of the nuclear component of small extensive air showers (EAS) with primary energies $E_0 \geq 10^3$ GeV. The simulations were completely three-dimensional and were initiated by cosmic rays sampled from both their primary energy and mass spectra. Resulting particle spectra sampled at 564 g cm^{-2} agree with extrapolations from observations of EAS with $E_0 > 10^{4-6}$ GeV. The optical Čerenkov radiation calculated for the nuclear-active particles and muons in these EAS is found to be comparable to that expected from the electrons and distinguishable for particular detector configurations. Implications for EAS observations of cosmic γ rays and cosmic-ray composition are mentioned. (auth)

30444 MIRRORING IN THE FOKKER-PLANCK COEFFICIENT FOR COSMIC-RAY PITCH-ANGLE SCATTERING IN HOMOGENEOUS MAGNETIC TURBULENCE. Goldstein, M.L.; Klimas, A.J. (Laboratory for Extraterrestrial Physics, NASA-Goddard Space Flight Center); Sandri, G. Astrophys. J. 195: No. 3, 787-799 (1 Feb 1975).

The Fokker-Planck coefficient for pitch-angle scattering, appropriate for cosmic rays in homogeneous, stationary magnetic turbulence, is computed from first principles. No assumptions are made concerning any special statistical symmetries the random field may have. This result can be used to compute the parallel diffusion coefficient for high-energy cosmic rays moving in strong turbulence, or low-energy cosmic rays moving in weak turbulence. Because of the generality of the magnetic turbulence which is allowed in this calculation, special interplanetary magnetic field features, such as discontinuities or particular wave modes, can be included rigorously The reduction of this result to previously available expressions for the pitch-angle scattering coefficient in random field models with special symmetries is discussed. The general existence of a Dirac δ-function in the pitch-angle scattering coefficient is demonstrated. It is proved in this paper that this delta function is the prediction of the Fokker-Planck equation for pitch-angle scattering due to mirroring in the magnetic field. The conditions under which this δ-function contributes to pitch-angle scattering are determined, and shown to be identical to the conditions under which first-order mirroring occurs in the random field. These conditions are generally fulfilled in interplanetary and probably interstellar space. The implications of the δ-function for the validity of the Fokker-Planck equation are discussed. (auth)

30445 COSMIC-RAY STREAMING AND ANISOTROPIES. Forman, M. A. (State Univ. of New York, Stony Brook (USA). Dept. of Earth and Space Sciences); Gleeson, L. J. (California Univ., La Jolla, San Diego (USA)). Astrophys. Space Sci.; 32: No. 1, 77-94(Jan 1975).

The principal result of this paper is the demonstration that in interplanetary space the electric-field drifts and convective flow parallel to the magnetic field of cosmic-ray particles combine as a simple convective flow with the solar wind. In addition there are diffusive currents and transverse gradient drift currents. With this interpretation direct reference to the interplanetary electric-field drifts is eliminated and the study of steady-state and transient cosmic-ray anisotropies is both more systematic and simpler. Following a discussion of the present knowledge of the diffusion coefficient in the interplanetary medium, the theory is applied to steady-state anisotropies near Earth in the kinetic energy (T) range 7.5 MeV < T < 20 GeV. First the theory of the diurnal variation at T ≥ 2 GeV is examined and it is suggested that the azimuthal streaming associated with the observations be regarded simply as proof that there is no significant net radial flow of cosmic rays at these energies. Second, it is predicted that, near Earth, the radial anisotropy will have a (+ − +) variation with energy and this prediction is very insensitive to the precise values of the parameters used: intensity spectrum, solar wind speed, radial density gradient, and diffusion coefficient. Then, third, the small and radial steady-state anisotropies reported by Rao et al. (1967) in the intervals 7.5 < T < 45 MeV and 45 < T < 90 MeV are reexamined and it is found that the gradients and diffusion coefficients required to produce the reported anisotropies in 7.5 < T < 45 MeV are inconsistent with those expected fron. other data. (auth)

30446 ROCKET OBSERVATION OF ENERGY SPECTRUM OF DIFFUSE HARD X-RAYS. Rukada, Y.; Hayakawa, S.; Ikeda, M.; Kasahara, I.; Makino, F.; Tanaka, Y. (Nagoya Univ. (Japan). Dept. of Physics). Astrophys. Space Sci.; 32: No. 1, L1-L5(Jan 1975).

The energy spectrum of diffuse hard X-rays measured in the range 10 to 40 keV shows a rather sharp change of slope. The logarithmic derivative of the spectrum changes around 10 to 30 keV by the increment significantly greater than 0.5 within an interval smaller than 50 keV. (auth)

30447 TEMPORAL DISTRIBUTION OF NEUTRON DENSITIES RECORDED IN A NEUTRON SUPERMONITOR. Chirkov, N. P.; Yanchukovskii, V. L. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 126-128(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 152-153(1974).

The recording of multiple neutrons, generated in neutron monitors, is widely used now as a means of obtaining additional information on cosmic-ray variations. To eliminate the indeterminacy in the selection of the collection time, the temporal density distribution of genetically related neutrons ρ being recorded in the monitor must be known. For this purpose, pertinent measurements were made to determine ρ on $\frac{1}{2}$ a section of the neutron monitor in respect to three triggering modes: random triggering (from the arbitrary "first" neutron), group triggering, and triggering from a meson telescope. The results obtained are shown. (MHR)

30448 THE DIFFUSE COSMIC GAMMA RADIATION. Schoenfelder, V. (Max-Planck-Institut fuer Physik und Astrophysik, Garching/Muenchen (F. R. Germany). Inst. fuer Extraterrestrische Physik). Naturwissenschaften; 61: No. 6, 250-256(Jun 1974). (In German).

Observation of diffuse cosmic gamma radiation can provide information that relates to much earlier ages of our universe than that obtainable from studies of other regions of the electromagnetic spectrum. The first part of this work briefly describes the experimental methods used and the measurements obtained; the second half discusses the origin of the diffuse gamma radiation. (auth)

30449 COSMIC-RAY INTENSITY MEASUREMENTS WITH THE MARS 2 AND MOLNIYA 1 CHERENKOV COUNTERS. Gorchakov, E. V.; Ignat'ev, P. P.; Galach'ev, N. G.; Yakovlev, V. A. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 568-571(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 625-628(1974).

The scientific equipment packages carried by the Mars 2 space probe (launched May 19, 1971) and the Molniya 1 [Lightning] earth satellite (launched December 20, 1971) included similar cosmic-ray Cherenkov counters. Type FÉU-31 A photomultipliers with a cylindrical plexiglas radiator 30 mm in diameter and in height were used. Singly-charged particles were recorded at a threshold energy of ~500 MeV/nucleon. The Mars 2 instrument had one channel for recording protons of this energy (electrons of energy above 7 MeV were also recorded), while the Molniya 1 instrument in addition had another channel with a threshold four times as high, for recording α particles. The directional patterns of these instruments were isotropic to within 10%. The statistical error of measurement was the same as the telemetry error for both the Molniya 1 satellite (~0.3%) and the Mars 2 probe (~0.2% with the averaging adopted). Further, the Molniya 1 instrumentation included two directional Cherenkov detectors (the end of the radiator opposite the photocathode was covered) oriented differently with respect to the axis pointing toward the sun. These detectors were equipped with FÉU-93 photomultipliers having a radiator 40 mm in diameter and 45 mm high. Information was received from Mars 2 until June 1, 1972, and from Molniya 1 until December 1, 1972. Some of the results obtained are described both with the two systems operating jointly and with Molniya 1 separately. (MHR)

30450 BIOLOGICAL EFFECT OF SUPERHARD COMPONENT OF COSMIC RAYS. Akoev, I. G.; Yurov, S. S.; Leont'eva, G. A.; Livanova, L. A.; Akhmadieva, A. Kh. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 562-567(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 617-624(1974).

The secondary emission generated on a target by 70-GeV protons and consisting mainly of hadrons was used for model investigations of the biological effect of the superhard component of the cosmic radiation. This component can have high biological effectiveness due to the multiple generation of secondary particles, their narrow angular distribution, and the probability of these secondary particles including multiply charged ions and antiprotons. (auth)

30451 HALO-DISK REPENETRATION OF THE COSMIC PARTICLES. Suh, P. K. (Grumman Aerospace Corp., Bethpage, NY). Astron. Astrophys.; 35: No. 3, 339-344(Oct 1974).

There are emerging evidences that the cosmic particles actively exchange positions between the disk and halo domains. The cosmic electron is used as a probe for the halo-disk repenetration probability, and various physical implications of the possible physical halo formation are examined. (auth)

30452 PHENOMENOLOGICAL STUDY OF COSMIC-RAY PROPAGATION: A CORRECTED DIFFUSION MODEL. Le Guet, F. (Observatoire de Nice); Stanton, M. Astron. Astrophys.; 35: No. 2, 165-169(Oct 1974).

It is shown that the mathematical solution of the transfer equation given by Le Guet and Pacheco (1973) for the propagation of cosmic nuclei is incorrect. The correction is given and it is found that in certain cases the diffusion coefficient can differ by about an order of magnitude from that obtained previously. (auth)

30453 ORIGIN OF LIGHT ELEMENTS (D TO B). Kowalski, M.; Kuchowicz, B. (Univ., Warsaw). Postepy Astron.; 22: No. 4, 297-312(Dec 1974). (In Polish).

The recent state of the problem of the L process of nucleosynthesis is outlined. In this process there are produced the following light nuclides: D, ^{3}He, Li (6 and 7), Be, and B (10 and 11). They are much less abundant in nature than the neighboring nuclides. Their relative overabundance in cosmic radiation may be attributed to spallation processes in space. While deuterium may be regarded as a remnant from the big bang, the remaining nuclides may be treated with a high probability as products of spallation reactions; this hypothesis is supported by laboratory measurements of spallation reactions on He, C, N, O, and Ne. (auth)

30454 MEAN LATERAL DENSITY DISTRIBUTION OF MUONS IN EXTENSIVE AIR SHOWERS DETECTED AT HAVERAH PARK. Armitage, M. L.; Blake, P. R.; Nash, W. F. (Univ. of Nottingham, Eng.). J. Phys., A (London); 7: No. 16, 2041-2051(1 Nov 1974).

This paper presents the results and conclusions from an experiment carried out between 1969 and 1973 at the Haverah Park cosmic-ray extensive air shower detector array near Harrogate, Yorkshire (UK). The detector consisted of 12 m^2 of shielded neon flash tubes sensitive to muons of energy greater than 300 sec θ MeV. The detector was situated at the center of the EAS array and its response to showers of primary energy 10^{17} eV $\lesssim E_p \lesssim 10^{19}$ eV, with zenith angles up to 60° has been studied. The analysis has been restricted to those showers in which the distance (R) from the core of the shower to the detector was in the interval 100 m < R < 1000 m. The results are compared with model calculations and a number of conclusions drawn. (auth)

30455 ENHANCED LOW-ENERGY GAMMA RAYS AT BALLOON ALTITUDE IN THE BRAZILIAN MAGNETIC ANOMALY. Martin, I. M.; Rai, D. B.; Palmeira, R. A. R.; Trivedi, N. B.; Abdu, M. A.; da Costa, J. M. (Instituto de Pesqwsas Espaciais, Sao Jose dos Campos, Brazil). Nature (London); 252: No. 5478, 25-27(1 Nov 1974).

It is stated that the region of the Brazilian geomagnetic anomaly affords a good opportunity for studying the precipitation of charged particles from inner radiation belts into the atmosphere. Some recent studies have shown that precipitation increases appreciably during geomagnetic storms, and the studies described in the present communication provide further evidence of this. Balloons with γ-ray and charged particle detectors were launched in October 1973 to an altitude of ~3.5 mbars during a magnetically disturbed period that lasted over a week. The Launchings were made from Sao Jose dos Compos. The results were compared with those obtained during a quiet period. The detector consisted of a NaI(Tl) scintillator surrounded by a plastic scintillator, the latter operating in anticoincidence to separate the charged particles. Curves of the integral count rates as a function of time are shown, and a substantial increase in the γ-ray flux was observed; the charged particle flux also showed enhancement, although not as large as for γ-rays. The increased count rate could be attributed to the high level of geomagnetic activity at the time. The fact that the increase in γ-ray flux was considerably larger than the charged particle flux could be attributed to the fact that the former was due primarily to bremsstrahlung produced by the downward moving electron flux. The energy spectrum of the incident γ-ray flux was measured. The exact manner in which the geomagnetic field variations produced the increased electron precipitation is not clear, but short period fluctuations in the geomagnetic field are believed to provide an effective mechanism. (UK)

30456 TEMPERATURE EFFECTS ON THE INTENSITY OF HIGH-ENERGY COSMIC-RAY μ-ONS. Munakata, Y. (Chubu Inst. of Tech., Kasugai, Aichi (Japan)). Mem. Chubu Inst. Technol.; 9: 103-105(Dec 1973).

Temperature effects on the intensity of cosmic ray μ-ons is investigated by statistical methods. The sign of temperature coefficient changes at the altitude of 300 millibar. The largest positive and negative temperature coefficients are 0.027 ± 0.013 (%/°C) at 200 millibar and −0.021 ± 0.011 (%/°C) at 600 millibar, respectively The barometer coefficient is −0.043 ± 0.006 (%/mb) on the ground. (auth)

30457 COSMIC RAY INTENSITY ANISOTROPY DURING THE BEGINNING PHASE OF FORBUSH DECREASE OF AUGUST 4, 1972. Chiba, T. (Iwate Univ., Morioka (Japan). Faculty of Education); Ishida, Y.; Kawasanki, S.; Kodama, M.; Wada, M. Rep. Ionosphere Space Res. Jap.; 27: No. 4, 163-169(1973).

Using the cosmic ray neutron data from 44 stations, the characteristics of the Forbush decrease which occurred on August 4, 1972 are investigated on an hourly basis in terms of intensity anisotropy during the beginning phase of the event. The decrease on the equatorial plane begins earlier in the garden-hose direction and latest in the anti-sun direction. It is found that the anisotropy in space persists for over 7 hours, its magnitude reaching a maximum of about 8 percent. (auth)

30458 IMPLICATIONS OF STRONG LEPTONIC INTERACTIONS FOR VERY HIGH ENERGY COSMIC RAY PHENOMENA. Giler, M.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 16, 2052-2058(1 Nov 1974).

An analysis is made of the implications for high-energy cosmic-ray phenomena of the interaction models of Pati and Salam (International Center for Theoretical Physics. Preprint IC/74/7 (1974)). The effect on the size spectrum of showers, the energy spectrum and angular distribution of high energy muons and the longitudinal developments of showers is considered. It is shown that the muon data enable a lower limit of 7×10^3 GeV to be placed on the total energy in the center-of-mass system for the onset of the phase where leptonic and semi-leptonic processes become strong. (auth)

30459 INTERPRETATION OF COSMIC RAY MUON DATA IN THE LIGHT OF RESULTS FROM THE INTERSECTING STORAGE RING EXPERIMENT. Erlykin, A. D.; Ng, L. K.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 16, 2059-2073(1 Nov 1974).

The latest ISR data on p−p collisions at effective energies approaching 2×10^3 GeV have been used together with information on the primary spectrum to calculate the expected charge ratio of cosmic-ray muons in the near vertical direction. It is found that the expected ratio is near to that observed for $E_\mu \simeq 30$ GeV without the necessity of assuming a breakdown in the validity of the limiting fragmentation hypothesis although the accelerator data are still not sufficiently precise to deny some small lack of validity. If the limiting fragmentation hypothesis continues to be valid at energies above 2×10^2 GeV and if the scaling hypothesis is applicable above 2×10^3 GeV, in particular if kaon production continues at the same rate, then it is necessary to assume that the relative flux of heavy nuclei in the primary cosmic-ray beam increases somewhat with energy. Previous analyses of the muon charge ratio are examined and the reasons for apparently discordant conclusions are indicated. (auth)

30460 ANALYSIS OF JET SHOWERS WITH AEROPLANE EMULSION CHAMBER. Maeda, Y. (Yokohama National Univ. (Japan). Faculty of Education). Uchusen Kenkyu; 18: No. 2, 183-196(Dec 1973). (In Japanese).

Trial experiment to observe charged secondary component and neutral secondary component with an emulsion cloud chamber on an aeroplane was performed. The aeroplane emulsion chamber (AEC) consisted of an upper chamber and a lower chamber. The upper chamber was composed of thin methacrylic plates and nuclear plates, and the lower chamber was composed of lead plates, nuclear plates and X-ray films. Jet showers were traced back upwards from cascade showers in the lower emulsion chamber. Multiplicity, angular distribution, and the mode of multiple scattering were observed. Energy distribution and angular distribution of the neutral component were also observed. Since charged secondary particles emitted at large angle may be overlooked, the modified F-plot method was applied for the analysis of charged secondary particles. The neutral component was analyzed by using an ordinary method. The results of analysis showed that the velocity of fire balls in the gravity center system is about 2, inelasticity increases with the increasing mass of fire balls, the ratio of energy of the charged component and the neutral component is about 2, and shows charge independence, and the ratio of number of secondary particles emitted forward and backward from individual fire balls in the gravity center system is nearly one. (JA)

30461 RELATIONSHIP OF THE SPECTRUM OF SEA LEVEL MUONS TO THAT OF THE PRIMARY COSMIC RAYS. Erlykin, A. D.; Ng, L. K.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 16, 2074-2084(1 Nov 1974).

An analysis is presented of the use of the spectrum of near vertical cosmic-ray muons in deriving the energy spectrum of primary cosmic-ray nucleons. The model used for high-energy

interactions in the atmosphere is that derived from ISR measurements, which cover the range 2.5×10^2 to 1.5×10^3 GeV, and their extrapolation. The effect of variations from straightforward extrapolation is also examined. The nucleon spectrum is used to derive alternative spectra of primary nuclei for different assumptions about the primary mass composition. An analysis is also given of the distribution of primary nucleon energies and primary rigidities which contribute to muons of various threshold energies. (auth)

Stars

Refer also to abstracts 30599, 30603, 30763, 31057, 31357, 31728, and 31741.

30462 (COO-1265-154, pp 38; 42-43) $^{17}O(p,\alpha)^{14}N$ REACTION RATE IN STARS. King, G. W.; Brown, R. E.; Dehnhard, D. Sep 1974.

In annual report 1974.

30463 (UCRL-76317) SOME MAGNETIC EFFECTS IN STELLAR COLLAPSE AND ACCRETION. Wilson, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1975. 21p. (CONF-741215-2). Dep. NTIS $4.25.

From seventh Texas symposium on relativistic astrophysics; Dallas, Texas, USA (16 Dec 1974).

Damour has previously discussed some magnetic effects to be expected when magnetized material is accreting onto a black hole. In order to obtain analytic solutions, it was necessary to ignore material and magnetic pressures. The work described here was done numerically with a computer so that finite fields and pressures could be treated. These calculations demonstrate actual energy extraction from the black hole in the case of accretion, and show heuristically how a charged black hole might form in collapse. (WDM)

30464 SEARCH FOR EFFECTS FROM INVISIBLE COMPONENTS IN SEVEN SPECTROSCOPIC BINARIES. Guseinov, O.Kh.; Novruzova, Kh.I.; Rakhamimov, Sh.Yu. (Shemakha Astrophysical Observatory, Academy of Sciences of the Azerbaidzhan SSR). Sov. Astron.—AJ 18: No. 4, 464-465 (Jan 1975).

Data are analyzed for the spectroscopic binary stars HD 28052, 31109, 37507, 56986, 104321, 110951, and 205767. Each of these has a massive invisible component which has been suggested as representing a relativistic star. The errors introduced in the reduction of the spectra are investigated. Possible explanations for the invisibility of the secondary components are discussed. The principal factor is that the massive invisible component actually is faint compared to the visible component. Of the seven binaries considered, the ω Eri system is the most promising object in which to seek a black hole. (auth)

30465 WEAK ABSORPTION LINES IN MAGNETIC STARS. Pavlov, G.G. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 4, 454-459 (Jan 1975).

Equations are derived for the profiles and integrated parameters of magnetic-star absorption lines on the linear part of the curve of growth (the Schuster-Schwarzchild model is adopted). The influence of stellar rotation and noncoherent radiation scattering upon the shifts and broadening of the line components is taken into account. The dependence of various line parameters on the choice of a line-formation mode is investigated for the case of an oblique rotator with a dipole field. Estimates are obtained of the broadening of a line and its Zeeman components by a nonuniform magnetic field and by rotation, as well as for the crossover effect. Magnetic broadening could be the principal absorption-line broadening mechanism in magnetic white dwarfs. (auth)

30466 HYDROGEN PROFILES, HELIUM LINE STRENGTHS, AND SURFACE GRAVITIES OF ECLIPSING BINARY STARS. Olson, E.C. (Department of Astronomy, University of Illinois, Urbana). Astrophys. J. Suppl. Ser. 29: No. 274, 43-54 (Jan 1975).

Coudé spectroscopy and four-color photometry are used to show that surface gravities of eclipsing binary stars determined from hydrogen line profiles and from theoretical profile grids are in agreement with gravities based on binary light and radial velocity solutions. Agreement is obtained with both the Griem and the Vidal-Cooper-Smith line-broadening theories. Agreement is also found for gravities determined from neutral helium line strengths for N (He)/N (H) $=0.1$. (auth)

30467 UV CETI FLARE STARS: OBSERVATIONAL DATA. Moffett, T.J. (Department of Astronomy, The University of Texas at Austin, and McDonald Observatory). Astrophys. J. Suppl. Ser. 29: No. 273, 1-42 (Dec 1974).

Photometric observations of UV Ceti flare stars during the period 1971—1972 are presented. Most observations were obtained using integration times of 1 s or less. Four—hundred and nine flares were detected during 469.2 hours of flare monitoring. The mean (B—V) of flare light for 77 flares was found to be $+0.34 \pm 0.44$, and the mean (U—B) for 153 flares was -0.88 ± 0.31. A discussion of the usefulness and limitation of various flare parameters is presented. (auth)

30468 INTERNAL MAGNETIC FIELDS OF PULSARS, WHITE DWARFS, AND OTHER STARS. O'Connell, R.F. (Department of Physics and Astronomy, Louisiana State Univeristy). Astrophys. J. 195: No. 3, 751-752 (1 Feb 1975).

The possibility that the very early magnetic fields in pulsars and other stars have a large number of nodes m in the radial function, has been considered by some authors. However, these analyses have not taken into account the fact that, as we shall show here, such large m values imply large internal magnetic fields. Such large fields could affect the interior dynamics and may also give rise to stability problems. (auth)

30469 THE EQUATIONS OF HYDRODYNAMICS FOR A THERMALLY CONDUCTING, VISCOUS, COMPRESSIBLE FLUID IN SPECIAL RELATIVITY. Greenberg, P.J. (Theoretical Physics Institute, University of Alberta). Astrophys. J. 195: No. 3, 761-772 (1 Feb 1975).

In this paper the equations of hydrodynamics governing the behavior of a thermally conducting, viscous, compressible fluid in special relativity are derived. We also derive the expressions (expansion, rotation, and shear) describing the kinematics of the fluid as seen by an observer comoving with an element of the fluid and employing three Fermi—transported, local, Cartesian axes. It is furthermore observed that there is the possibility for waves of viscosity to exist in the fluid, and we determine, in the case of one—dimensional flow, the conditions for the existence of these waves. (auth)

30470 ROTATIONAL VELOCITIES IN IC 2602. Levato, H. (Observatorio Astronómico, La Plata, Argentina). Astrophys. J. 195: No. 3, 825-827 (1 Feb 1975).

Rotational velocities for 20 members of IC 2602 are determined. Their values show that they are, on the average, fast rotators. (auth)

30471 STEADY—STATE NUCLEAR FUSION IN ACCRETING NEUTRON—STAR ENVELOPES. Hansen, C.J.; Van Horn, H.M. (Joint Institute for Laboratory Astrophysics, University of Colorado). Astrophys. J. 195: No. 3, 735-741 (1 Feb 1975).

Conditions in the envelopes of accreting neutron stars are shown to require thermonuclear burning of hydrogen and helium in thin shells. Numerical models of such envelopes are constructed for neutron stars with $M = 0.0925$, 0.476, and 1.41 $M_\odot$ and for spherically symmetric accretion rates of $\dot{M} = 10^{-11}$, 10^{-9}, and 10^{-7} $M_\odot$ yr^{-1}. Almost all of the shells are found to be thermally unstable, with the growth rate of the instability ranging from milliseconds to months. A crude model of nonspherical accretion is also considered and found to resemble roughly the spherical accretion problem with the same accretion rate per unit area. (auth)

30472 SLOWLY BRAKED, ROTATING NEUTRON STARS. Sato, H. (Department of Physics, University of California, Berkeley). Astrophys. J. 195: No. 3, 743-749 (1 Feb 1975).

A slowly braked, rotating neutron star is believed to be a star which rapidly rotates, has no nebula, is nonpulsing, and has a long initial braking time of $\sim 10^5$ to 10^6 years because of a low magnetic field. Such an object might be observable as an extended weak source of infrared or radio wave radiation due to the scattering of low—frequency strong—wave photons by accelerated electrons. If these objects exist abundantly in the Galaxy, they would act as sources of relatively low—energy cosmic rays. Pulsars (rapidly braked neutron stars) are shown to have difficulties in providing an adequate amount of cosmic—ray matter, making these new sources seem necessary. The possibility that the acceleration mechanism around a slowly braked star may be not a direct acceleration by the strong wave but an acceleration due to plasma turbulence excited by the strong wave is briefly explored. It is shown that white dwarfs may also be slowly braked stars with braking times longer than $10^{6.5}$ years. (auth)

30473 SUPERNOVA REMNANTS AND PRESUPERNOVA MODELS. Arnett, W.D. (Department of Astronomy, University of Texas, Austin). Astrophys. J. 195: No. 3, 727-733 (1 Feb 1975).

Preliminary models of stellar evolution and neutron—star formation, taken with simple models of the Crab Nebula and its pulsar, and of Cas A, can give a coherent picture of the origin of these objects. Energetics, abundances of elements in the nebulae, and characteristics of the neutron star are examined. (auth)

30474 PHOTOELECTRIC OBSERVATIONS OF KRZEMINSKI'S STAR, THE COMPANION OF CENTAURUS X—3. Petro, L.D. (University of Michigan). Astrophys. J. 195: No. 3, 709-713 (1 Feb 1975).

V—magnitudes of Kreminski's star and their interpretation are presented. We find $M_{\text{primary}} = 20.5 \pm 3.5\ M_\odot$, $M_x = 2.5 \pm 1.1\ M_\odot$, $\sin i = 0.985 \pm 0.02$, and $q = 0.12 \pm 0.05$. (auth)

30475 A POSSIBLE WIDTH—LUMINOSITY CORRELATION OF THE CA II K_1 AND Mg II k_1 FEATURES. Ayres, T.R.; Linsky, J.L.; Shine, R.A. (Joint Institute for Laboratory Astrophysics, University

of Colorado and National Bureau of Standards, Boulder, Colorado). Astrophys. J. Lett. 195: No. 3, L121-L124 (1 Feb 1975).

Existing high resolution stellar profiles of the Ca II and Mg II resonance lines suggest a possible width–luminosity correlation of the K_1 minimum features. We show that such a correlation can be simply understood if the continuum optical depth of the stellar temperature minimum, τ_c^*, is relatively independent of surface gravity as suggested by three stars studied in detail. (auth)

30476 IDENTIFICATION OF THE 890 cm^{-1} CARBONATE SIGNATURE IN NGC 7027. Bregman, J.D.; Rank, D.M. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. Lett. 195: No. 3, L125-L126 (1 Feb 1975).

High–resolution spectroscopic measurements of the 11 μ continuum emission from NGC 7027 indicate that $MgCO_3$ is a constituent of the dust in the nebula. Other carbonate compounds may also be present in concentrations approximately 1 order of magnitude below that of $MgCO_3$. Dust–grain temperatures combined with the abundance of $MgCO_3$ require that most of the material composing the grains must be carbon or C, N, O compounds. (auth)

30477 T TAURI NEBULAE AND HERBIG–HARO NEBULAE: EVIDENCE FOR EXCITATION BY A STRONG STELLAR WIND. Schwartz, R.D. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. 195: No. 3, 631-642 (1 Feb 1975).

Radial velocities of the emission nebulae and NGC 1555 (Hind's Reflection Nebula) which are associated with T Tau suggest the presence of extended mass outflow which is supersonic with respect to the medium in which the star is embedded. It is suggested that radiating shocks may form where the flow interfaces with the intracloud medium, producing emission spectra similar to that predicted by the shock–wave models of Cox. An N_e, T_e analysis based upon the relative intensities of the near–infrared and blue lines of [O II] in Burnham's Emission Nebula supports the shock wave hypothesis. The character of the emission–line spectrum, the small filling factor, and the energy balance requirements of the system are also compatible with the hypothesis. The Herbig–Haro Nebulae, if produced by the same mechanism, must involve central objects with a considerably higher rate of mass outflow than it indicated for T Tau. (auth)

30478 STELLAR FLUX MEASUREMENTS OF EARLY–TYPE STARS IN THE 912–1075 Å BAND. Troy, B.E. Jr.; Johnson, C.Y.; Young, J.M.; Holmes, J.C. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D. C.). Astrophys. J. 195: No. 3, 643-648 (1 Feb 1975).

Stellar flux measurements in the wavelength range 912–1075 Å (λ_0=950 Å) are presented for eight OB type stars. These measurements were obtained from two photometers aboard a rocket flown from White Sands, N.M., on 1971 October 8. The ultraviolet color index $(m_{950}-V)$, derived from the flux values varies from approximately −6 to −4 between spectral classes O8 and B2. Radiation from B3 and later stars was below our detectable limit. The variation of the 950 Å color index with spectral type is similar to, but steeper than, that of the 1115 Å and 1376 Å indices, and more negative in value. The derived color indices are consistently more negative than predictions from model atmosphere calculations. (auth)

30479 OBSERVATIONS OF LITHIUM DILUTION AND ROTATIONAL VELOCITY DECAY IN F AND G GIANT STARS. Alschuler, W.R. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. 195: No. 3, 649-660 (1 Feb 1975).

Lithium abundances and rotational velocities have been determined for 64 stars between F4 III and G5 III, from Lick coudé image tube spectrograms of dispersion 16 Å mm^{-1}. These results can be compared with theoretical predictions of Li convective dilution and rotational velocity decay for masses 2.4 to 3.0 $\mathfrak{M}_\odot$. If all these stars are crossing the Hertzsprung gap for the first time since leaving the main sequence, then theory and observation do not entirely agree. A satisfactory agreement with observation could be achieved by adjustments to the models, possibly through a modification of the mixing–length theory of convection. Without such modification it would be necessary to assume that there is a systematic increase in the sampled mean mass between F4 III and G5 III, which implies that these samples are drawn from different regions of the zero–age main sequence having different initial Li abundances. (auth)

30480 THE CLASSIFICATION OF INTRINSIC VARIABLES. V. THE LARGE–AMPLITUDE RED VARIABLES. Eggen, O.J. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, The Australian National University). Astrophys. J. 195: No. 3, 661-678 (1 Feb 1975).

(UBVRI) observations covering several cycles of 10 large–amplitude red field variables and three probable group members are discussed. The individual observations are published separately in a supplement. Although large variations occur between cycles on the rising branches and at maxima in the light curves, the curves for different cycles coalesce on the descending branch from phase 0.25 near minimum light. Median values of the magnitude in all colors, obtained from light curves in intensity units, are closely approximated by observed values at phase 0.25. When the giant sequence in the $(M_{bol}, R-I)$ –plane, obtained from constant stars, is extended to higher luminosities through the use of median magnitudes of small–and intermediate–variables, the large–amplitude variables lie near this sequence at phase 0.25. The median luminosities are closely approximated by the color–luminosity relation $\langle M_{bol}\rangle = -0.65 \text{ mag} - 2.5\langle (R-I)_0\rangle$, where $\langle (R-I)\rangle$ is used at phase 0.25. Because the periods and median colors are well correlated for the large–amplitude variables, $\langle (R-I)_0\rangle = -0.45 \text{ mag} + 0.90 \log P$, the color–luminosity relation is also a period–luminosity relation, $\langle M_{bol}\rangle = +0.5 \text{ mag} - 2.25 \log P$. However, the well determined bolometric corrections for stars with periods between 100 and 500 days are closely correlated with color, B.C. $= +0.60 \text{ mag} - 2.5(R-I)$, so no period–luminosity relation is expected in the visual luminosities over this range of period, $\langle M_v\rangle = 1.25$ mag. (auth)

30481 SODIUM LINE FORMATION IN ARCTURUS. Kelch, W.L. (Astronomy Department, Indiana Univeristy, Bloomington). Astrophys. J. 195: No. 3, 679-687 (1 Feb 1975).

Results of an investigation of the sodium line formation in the K2 III*p* giant Arcturus are given. A model Na I atom of eight bound levels is used, and the radiative transfer problem is solved by the method of complete linearization. We compare predictions of the D line profiles and central intensities of the $3p-3d$, $3p-5s$, and $3p-4d$ multiplets with Griffin's Photometric Atlas of Arcturus. The local thermodynamic equilibrium (LTE) approximation predicts the D lines and all the subordinate transitions mentioned above to be weaker than as seen in the Arcturus Atlas. It is found that although the resonance lines computed by non–LTE or kinetic equilibrium (KE) differ little from LTE and do not fit the observations well (except in the case of an increase in the microturbulence with depth), the subordinate lines differ significantly from LTE and fit the observations much better. Using a T_{eff}=4100°K rather than a T_{eff} =4250°K model atmosphere gives better agreement between theory and observation for the D lines and good agreement for the $3p-5s$ and $3p-4d$ lines, whereas LTE still does not fit the subordinate lines. The $3p-3d$, $3p-4d$, and $3p-5s$ sets of lines, at 8183.3 and 8194.8 Å, 5682.6 and 5688.2 Å, and 6154.2 and 6160.7 Å, respectively, should offer a good observational test of the validity of the LTE approximation for sodium in cool stars in general. (auth)

30482 CIRCUMSTELLAR DUST SHELL MODELS FOR ALPHA ORIONIS. Dyck, H.M.; Simon, T. (Institute for Astronomy, University of Hawaii). Astrophys. J. 195: No. 3, 689-693 (1 Feb 1975).

We present the results from some simple calculations of optically thin dust shell models for α Ori. We show that (1) the mass in the shell is large, $3\times10^{-5} - 1\times10^{-2}\ M_\odot$, but compatible with the current picture of mass–loss; and (2) photometry at wavelengths greater than 20μ can help to distinguish among various density distributions in the shell. (auth)

30483 CHEMICAL ABUNDANCES OF PLANETARY NEBULAE. Boeshaar, G.O. (Perkins Observatory, The Ohio State and Ohio Wesleyan Universities). Astrophys. J. 195: No. 3, 695-704 (1 Feb 1975).

A procedure for measuring chemical abundances from emission–line spectra is presented that accounts for small–scale changes in ionization, temperature, and density within the source. Applied to the spectral data for six planetary nebulae, this method appears consistent in the allowance for both filamentary structure and unobserved ionization stages. Only general indications are found for the magnitude of the correction needed to account for both collisional excitation and self–absorption effects on the He/H value. With respect to previous results, there is a decrease in the abundance of the heavier elements. The N/O enrichment reported by other investigators is found to be real and to be correlated with the population type of the objects. Applications to the study of H II regions and the gas content of other galaxies are discussed. (auth)

30484 THE MEAN VELOCITIES OF THE STARS IN 58 GLOBULAR STAR CLUSTERS. Lohmann, W. (Astronomisches Rechen-Institut, Heidelberg, F. R. Germany). Astrophys. Space Sci.; 32: No. 1, 153-163(Jan 1975). (In German).

The mean velocities of the stars in 58 globular clusters are derived from the photometric measurements of Kron and Mayall (1960). The mass-visual brightness ration $M/H = 0.935\ M_\odot/H_\odot$ is used. The velocities are falling in the interval $2.9 \le \bar{v} \le 11.6$ km s^{-1}, their mean value is 6.75 km s^{-1}. (auth)

30485 THE PHYSICAL CONDITIONS IN THE SHELLS OF TYPE I SUPERNOVAE. Mustel, E. R.; Chugay, N. N. (Astronomical Council of the USSR Academy of Sciences, Moscow, USSR). Astrophys. Space Sci.; 32: No. 1, 39-53(Jan 1975).

Two models of the origin of the spectrum of type I supernovae

are analysed: (I) the photosphere of the "central remnant" and the expanding shell are separated by a density cavity; (II) the "photosphere" (the layer which produces the continuous spectrum) is the inner part of the expanding shell. The arguments are given in favour of model I. Opacity of the shell close to light maximum for $\lambda > 4000$ Å is mostly due to Thomson scattering; soon after light maximum (and it may be already at light maximum) the shell becomes completely transparent in this region of the spectrum. The problem of the origin of the very large width and of the relatively high central residual intensities of the absorption lines in the spectra of type I supernovae are analysed. A very noticeable dispersion in the velocities of the radial gas motions in the shell is the principal cause of the large equivalent width of the absorption lines in the spectra of these supernovae. The role played by the inhomogeneities in the shell is also discussed. The depth of the strong absorption lines produced by a very inhomogeneous shell may be equal to the filling factor of the medium. From the analysis of the spectra of supernova 1972e a lower limit for the mass of the shell is obtained ($M > 10^{31}$ g). Then from the fact of absence of a detectable H-absorption line and a simultaneous presence of strong Si II absorption lines (6347, 6371 Å) in the spectrum of supernova 1972e it follows that the ratio Si/H is at least two or three orders greater than that for the "normal" stars. (auth)

30486 NUMERICAL SIMULATION OF THE PLASMA DOUBLE LAYER. Goertz, C. K.; Joyce, G. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Astrophys. Space Sci.; 32: No. 1, 165-173(Jan 1975).

A one-dimensional particle-in-cell computer simulation is used to model the formation of an electrostatic double layer. The conditions for the onset of the layer formation are explored and a relation between the length of the layer and the electrostatic potential difference across is found. (auth)

30487 THE EQUATION OF STATE FOR NEUTRON STARS. Ferrini, F. (Scuola Normale Superiore, Pisa (Italy)). Astrophys. Space Sci.; 32: No. 1, 231-247(Jan 1975).

The results are presented of an improved analysis of the equation of state of matter from metallic to nuclear density which takes into account: (a) in the region of low densities ($\rho < 10^4$ g cm^{-3}), the electron correlation energy in the lattice; (b) in the region of medium density ($10^4 < \rho < 4.3 \times 10^{11}$ g cm^{-3}) a more refined discussion of the electron energy; (c) in the region of large densitites (4.3×10^{11} g cm$^{-3} < \rho$) a new method for determining the surface nuclear energy based on the Thomas–Fermi method. The equation of state which is obtained shows no discontinuity at the boundaries between the different regions. (auth)

30488 FOUR NEW B EMISSION-LINE STARS. Boulon, J.; Doazan, V.; Letourneur, N. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 33: No. 3, 473-475(Jul 1974). (In French).

A description is given of the spectra of four new B emission-line stars. Previous studies show they present at least one character of variability commonly observed among Be stars: radial velocity, profile, or light. (auth)

30489 SHORT-TERM LIGHT VARIATIONS OF S DOR AND HD 37836. Appenzeller, I. (Univ. Sternwarte, Goettingen, Ger.). Astron. Astrophys.; 32: No. 4, 469-470(Jun 1974).

New observations confirm that the two peculiar high luminosity stars S Dor and HD 37836 in the Large Magellanic Cloud show detectable light variations on time scales of a few hours. The observed variations seem to be of irregular nature. They do not support the assumption that the two stars are vibrationally unstable massive main-sequence stars. (auth)

30490 DETECTION OF CROSSOVER EFFECT IN THE AP STAR HD 98088. Hensberge, G. (Univ., Amsterdam). Astron. Astrophys.; 32: No. 4, 457-459(Jun 1974).

On a high dispersion Zeeman plate of the Eu–Cr–Sr star HD 98088 several lines of Fe, Cr, and Ti show the crossover effect. The mean effective field strength in the magnetic regions where the lines arise is -8400 ± 450 and $+7600 \pm 400$ Gauss, respectively. Different ions show slightly different field strengths. (auth)

30491 SPECTRUM VARIABILITY OF SIGMA ORI E. Hunger, K. (Technische Univ., Berlin). Astron. Astrophys.; 32: No. 4, 449-451(Jun 1974).

The hydrogen-deficient star σ Ori E is found to be spectrum variable: the equivalent widths of all measured He I-lines (a total of 7 within 4010 Å $< \lambda <$ 4500 Å) vary consistently with an amplitude of up to 48%. The Si III-lines λ 4553 and 4568 vary in antiphase, with an amplitude of 54%. H_γ and H_δ are constant within $\lesssim$12%. Mg II λ 4481 and C II λ 4267 also appear to be constant. The time scale of the variations seems to be less than a day or probably one hour. The variability is similar to that found in α Centauri. (auth)

30492 DETECTION OF AP STARS IN THE GENEVA PHOTOMETRIC SYSTEM. Hauck, B. (Univ. Lausanne, Switzerland). Astron. Astrophys.; 32: No. 4, 447-448(Jun 1974).

Using the photometric diagrams of the Geneva system, it is shown that it is possible to detect the Ap stars by photometry. Two stars (HD 47756 and HD 72524) considered as normal stars in the literature appear as "photometrically" Ap stars. (auth)

30493 LIGHT VARIATIONS IN SEVEN WOLF–RAYET STARS. Moffat, A. F. J. (Ruhr Univ., Bochum, Ger.); Haupt, W. Astron. Astrophys.; 32: No. 4, 435-439(Jun 1974).

Extensive photometric observations in the continuum and emission lines of seven Wolf–Rayet stars yield no significant (above the ca. 0.5% level) short period ($2 \text{ min} \lesssim P \lesssim 1$ h) oscillations as one might expect if they are massive He- or C-burning stars at the upper limit of pulsational stability. However, four of the stars, three of them "single", show variations over the three hour measuring interval, which tend to be larger in the emission lines than in the continuum. This is interpreted in terms of the binary nature of the Wolf–Rayet phenomenon. (auth)

30494 ORBITAL ELEMENTS AND DIMENSIONS OF TWO DOUBLE-LINES ECLIPSING BINARIES: W GRU AND UX MEN. Imbert, M. (Observatoire, Marseille). Astron. Astrophys.; 32: No. 4, 429-434(Jun 1974). (In French).

The orbital elements were determined for eclipsing binary W Gru from 20 double-line spectra. The orbital parameters were computed, from measurements of the final elements, with three FORTRAN IV programs by means of an IBM 1130 computer. For the double-line eclipsing binary UX Men, the orbital elements were determined from 10 radial velocity plates. The orbital parameters were computed in the same way as for W Gru. (WDM)

30495 CONVECTION IN STELLAR ATMOSPHERES. Nordlund, A. (Univ., Stockholm). Astron. Astrophys.; 32: No. 4, 407-422(Jun 1974).

Three nonlocal theories of stellar convection are discussed. Two of these, due to Ulrich and Spiegel, predict convective fluxes widely different from those predicted by local mixing-length theory. With the aid of differential equations for the vertical velocity, excess temperature, and excess energy of fluctuations in turbulent convective layers, the importance of radiative and turbulent exchange is discussed. It is found that the amount of radiative cooling effectively determines the importance of convective flux relative to radiative flux, and that the turbulent dilution of kinetic energy determines the convective velocities. A parametrization of the rate of turbulent dilution in terms of a mixing length allows local mixing-length theory expressions for the convective flux to be obtained in the limit of slowly varying conditions. A local approximation for the ratio between excess energy and vertical velocity is found to give expressions for the convective flux in close agreement with expressions given previously by Parsons. The numerical investigation applies powerful difference equation methods to radiative transfer; this is used to construct an iterative Newton–Raphson procedure producing realistic fluxconstant models including nonlocal convection. By comparing models with different convection theories and by analyzing the importance of radiative cooling, it is concluded that the first two theories noted above overestimate the importance of convection in the visible layers of giants and solar-type stars. A quantitative measure of the importance of the convective flux in the visible layers is introduced, and it is concluded that this quantity is small in main-sequence stars and in giants whose effective temperatures exceed approximately 5000°K and 4000°K, respectively. (auth)

30496 SUPERGIANT STARS AS CHEMICAL COMPOSITION INDICATORS. Bertelli, G.; Chiosi, C. (Univ. Padua). Astron. Astrophys.; 32: No. 4, 399-406(Jun 1974).

A new calibration relation in terms of the metal content Z is found for evolutionary models of massive stars in the post main sequence phases. It turns out that the mean difference between red and blue visual magnitudes of supergiant stars linearly depends on the metal content only. This relation is applied to investigate a possible variation of the heavy elements abundance of very young stars in galaxies of different luminosity and morphological type. (auth)

30497 AXIAL ROTATION OF STARS ALONG THE MAIN SEQUENCE. Bernacca, P. L. (Univ. of Padua); Perinotto, M. Astron. Astrophys.; 33: No. 3, 443-450(Jul 1974).

The behavior of the mean equatorial rotational velocity $\langle v \rangle$ along the main sequence is investigated by a thorough statistical analysis of a large number of objects. Cluster and field stars between type B 5 and type A 8 have the same $\langle v \rangle$. Earlier than B 5 and later than A 8, field stars rotate slower than their cluster's counterparts, suggesting that some braking mechanism acts so as to reduce equatorial rotation in these spectral ranges during the life-time of a star on the main sequence. The braking time scale for F-type stars is of the order of 10^8 yr. (auth)

30498 VARIATIONS IN THE SPECTRUM OF β CEPHEI. Goldberg, B. A. (Univ. of British Columbia, Vancouver); Walker, G. A. H.; Odgers, G. J. Astron. Astrophys.; 32: No. 4, 355-362 (Jun 1974).

Spectrophotometric observations of the pulsating star β Cephei were made with a detection system employing Image Isocon and Silicon Diode Vidicon television cameras as detectors. The Isocon was used to monitor the lines of Si III $\lambda\lambda$ 4553 and 4568 for ≈0.8 cycle of the pulsation (P = 4.6 hours) and the Vidicon to monitor Hα for ≈1.0 cycle. The profiles of the Si III lines were found to vary systematically throughout the cycle, their asymmetries changing with relation to the radial velocities. The result provides the most conclusive evidence so far that the line profile variations are caused by radial pulsations of the stellar atmosphere. There are some indications of phase-dependent differential motion. Noncentral filling-in of the Hα absorption line by emission occurs near the phase of maximum radius. This has been demonstrated by the new Vidicon data as well as by previous studies. A general picture of the line profile variation is given based on both past and present observations. (auth)

30499 IONIZATION EQUILIBRIUM OF HERBIG–HARO OBJECTS AND TRANSITION RADIATION. Gurzadyan, G. A. (Space Astronomy Lab., Erevan). Astron. Astrophys.; 33: No. 2, 307-310(Jul 1974).

If it is assumed that fast electrons with an energy of the order of 1.5 MeV exist in Herbig–Haro objects, and that these electrons generate transition radiation through their electro-dynamic interaction with dust particles, one can, in principle, account for the observed luminosities and spectral structures of these anomalous objects. The spectrum of ionizing radiation of transition origin was calculated. The solutions of the equations of radiation transfer for both L_c-radiation and optical radiation under the conditions prevalent in Herbig–Haro objects are given. The formula for hydrogen ionization was derived; it is shown that the ionization degree in Herbig–Haro objects must be low ($N^+ \sim N_t$). The spectrum of transition radiation, when the energy of the fast electrons is 1.5 MeV, accounts also for the observed ratio of the intensities of the emission lines [O III] and [O II]. The theory was applied to Herbig–Haro object No. 1 and its energy and optical characteristics were determined. (auth)

30500 FINE ANALYSIS OF THE HELIUM-RICH STAR HD 184927. Higginbotham, N. A.; Lee, P. (Louisiana State Univ., Baton Rouge). Astron. Astrophys.; 33: No. 2, 277-288(Jul 1974).

An LTE fine analysis of the helium-rich star HD 184927 was performed by using a grid of flux-constant model atmospheres. Observational material included both high (6.5 Å/mm) and moderate dispersion spectrograms covering the spectral region λ 3600 Å to λ 6200 Å and moderate resolution spectral scans. The final model was adopted to match the following criteria: (1) equal hydrogen abundance from both the hydrogen and helium equivalent widths, (2) ionization equilibria of Si II/Si III and S II/S III, (3) Hγ and Hδ profiles, (4) He I, $\lambda\lambda$ 4471, 4388, 4143 profiles, and (5) the continuous flux distribution (Balmer discontinuity). A micro-turbulent velocity was determined from the metallic lines. This model is parameterized by: T_{eff} = 22,500°K, n_{He} = 0.50, log g = 3.80, v_t = 6 km/s. The metal abundances are approximately normal, except for S, Ar, and Fe which may be slightly overabundant. Mass, radius, luminosity, and distance were determined to be M = 12.4 $M_\odot$, R = 7.3 $R_\odot$, log($L/L_\odot$) = 4.1, and r = 1260 pc. These values of mass, radius, and luminosity are typical for helium-rich, or hydrogen-deficient, stars of which σ Ori E may be called a prototype. (auth)

30501 ABSOLUTE FLUXES OF K CHROMOSPHERIC EMISSION IN MAIN-SEQUENCE STARS. Blanco, C.; Catalano, S.; Marilli, E.; Rodono, M. (Univ., Catania, Italy). Astron. Astrophys.; 33: No. 2, 257-264(Jul 1974).

From new observations of the K emission line of Ca II and additional data from various sources, absolute fluxes from the chromospheres of main sequence stars were estimated. The analysis of these data lead to the following conclusions: i) for stars with T_{eff} < 5000°K, the theoretical acoustic energy flux, which is commonly assumed as responsible for the heating of chromospheres and coronae, is inadequate—by two orders of magnitude for the coolest stars—in accounting for the observed chromospheric emission flux; ii) the decay of the K emission line flux as the inverse root, square of star age (Skumanich, 1972) is proved to be valid in the range 4×10^7 to 1.5×10^9 years; the Sun as a whole does not fit in with this relation unless only magnetically active regions are considered; iii) for stars of a given age, the K emission line flux, normalized to the star bolometric flux, has a maximum at the spectral type K 0. (auth)

30502 LIFETIME MEASUREMENT OF EXCITED NICKEL I LEVELS. Becker, U.; Goebel, L. H.; Klotz, W. D. (Technische Univ., Berlin). Astron. Astrophys.; 33: No. 2, 241-247(Jul 1974).

Eighteen excited Ni I-levels were investigated with respect to the lifetimes by means of the zero-field level-crossing method. The spectral lines under investigation had wavelengths in the region of 3000 to 4000 Å and were due to transitions between the excited odd configurations $3d^9$ 4p and $3d^8$ 4s4p and the ground configurations $3d^9$ 4s and $3d^8$ $4s^2$. For most of the measured values the errors were estimated to be only a few percent which enables one to calculate absolute oscillator strengths. These f-values are compared with those of other authors. (auth)

30503 LINE-BLANKETING AND MODEL STELLAR ATMOSPHERES. I. Statistical Method and Calculation of a Grid of Model. Peytremann, E. (Univ., Mons, Belgium). Astron. Astrophys.; 33: No. 2, 203-214(Jul 1974).

A statistical method for the computation of line-blanketed model stellar atmospheres is described. It is shown that the integrals over frequency of several monochromatic quantities needed for the temperature–depth correction procedure, can be evaluated with sufficient accuracy by using as few as about 600 frequency points, even in the presence of thousands of lines. It is required however that these points be chosen at random with respect to the line-center frequencies. In order to apply this method, one needed a set of line data (mainly gf-values) which turned out to be insufficient at the time this work was done. By careful comparison with the solar spectrum, a basis set of data (Corliss and Bozman, 1962) was adjusted so that one was able to reproduce, on the average, the solar spectrum. A check of the method was then performed by calculating a blanketed solar model, which was compared to the Harvard Smithsonian Reference Atmosphere. A grid of blanketed stellar atmospheres was computed in the range $5000 \leq T_{eff} \leq 8500$(°K) $2 \leq \log g \leq 4.5$, and $\chi = 0, 0.1, 1$ (here χ is a factor by which the solar abundances of elements other than H and He, are scaled). Finally, some of the results are discussed, in terms of backwarming and surface cooling. The models themselves will be published separately. (auth)

30504 MORE ABOUT THE NUCLEOSYNTHESIS OF THE NUCLEI BETWEEN CARBON AND NEON. Arnould, M.; Beelen, W. (Univ. Libre, Brussels). Astron. Astrophys.; 33: No. 2, 215-230(Jul 1974).

Using Arnett's (1969) model of explosive nucleosynthesis, and as an extension of the work of Howard et al. (1971), the explosive processing of four compositionally different types of layers possibly surrounding an evolved C–O stellar core was studied. It appears that the explosive burning of so-called CNO layers (zones partially depleted with hydrogen before the explosion essentially by the operation of the low-temperature CNO cycle) can lead in the most favorable conditions to the production in their solar relative amounts of ^{13}C, ^{14}N, ^{15}N, ^{17}O, ^{21}Ne, and ^{22}Ne; alternatively, the explosive processing of certain CNO layers might perhaps provide an explanation for the origin of the low abundance trapped neon component with $^{20}Ne/^{22}Ne \lesssim 3.4$ observed in various C 1 and C 2 carbonaceous chondrites. The limiting cases of a CNO layer, i.e., undepleted or totally depleted hydrogen zones, are also considered: in the former case, ^{13}C, ^{15}N, and ^{17}O can sometimes be produced in their correct solar relative amounts, whereas, in the latter case (He layers), the use of a new rate of the reaction $^{14}N(\alpha,\gamma)^{18}F$ affects the results of Howard et al. (1971) in some explosion conditions, but leaves however unchanged their main conclusion that ^{15}N, ^{18}O, ^{19}F, and ^{21}Ne might issue in their solar ratios from certain explosively processed He layers. Moreover, various nuclei, and particularly ^{12}C, ^{18}O, ^{19}F, ^{21}Ne, and ^{22}Ne could also be produced in their solar ratios during the explosion of partially helium depleted layers (3α zones). Finally, well selected mixtures of certain of the above mentioned explosively processed layers can reproduce with a good approximation the solar relative abundances of the nuclei between C and Ne, with the exception of ^{16}O, ^{20}Ne and possibly also of ^{12}C, such a result being obtained by calling for only one type of astrophysical event and moreover possibly for a single star. (auth)

30505 ELECTRON IMPACT EXCITATION OF METASTABLE HELIUM-LIKE IONS. Tully, J. A.; Serrao, J. M. P. (Instituto Astronomico e Geofisico, Sao Paulo, Brazil). Astron. Astrophys.; 33: No. 2, 187-189(Jul 1974).

The Coulomb–Born approximation was used to study collisional excitation of the transitions $2^1S \rightarrow n^1S$, n^1P and $2^3S \rightarrow n^3S$, n^3P in positive ions of the helium isoelectronic sequence. Scaled collision strengths were tabulated as functions of (a) the atomic number Z and (b) the incident electron energy in threshold units X_0. f-values for the optically allowed transitions were calculated in the dipole-length approximation. (auth)

30506 SIMULTANEOUS SPECTROSCOPIC AND PHOTOELECTRIC OBSERVATIONS OF THE T TAURI STAR RU LUPI. Gahm, G. F.; Nordh, H. L.; Olofsson, S. G.; Carlborg, N. C. J. (Stockholm Observatory). Astron. Astrophys.; 33: No. 3, 399-411(Jul 1974).

The T Tauri star RU Lupi was followed through 9 nights in 12 photometric bands from 3490 Å to 10410 Å. Simultaneously, coudé-spectrograms were taken at a dispersion of 20 Å/mm. During this period the star was observed in states of increasing, decreasing, and almost constant brightness. The light variations occur simultaneously in all photometric bands, and the color variations follow an extinction law of the Cepheus type. The emission line spectrum of metals and hydrogen is consistent with an average temperature of 6150 K and a log $N_e = 11.5$ (cm^{-3}). The presence of a nearly continuous mat of weak unresolved and blended emission lines, of mainly Fe I, produces what could erroneously be taken for a blue excess continuum. The energy distribution is described by a stellar continuum of $T_{eff} = 4400$ K, log g = 4; an optically thin chromospheric hydrogen free–bound and free–free emission and a blackbody radiation from a 700 K dust envelope. The spectral temperature and density, the widths and symmetries of the emission lines, and the ratios of line intensities to continuum intensities do not change appreciably with time. The cause of the light variations is found to be variable circumstellar extinction. The time-scale of the variations is such that if the variations are due to dust concentrations moving in Kepler orbits round the star, these concentrations are of stellar dimensions and move at planetary distances. The characteristic mass of one concentration is of the order of 10^{21} g. In this view, RU Lup is a good candidate for a star with a protoplanetary system. (auth)

30507 INVERSION OF EMISSION LINE SPECTRA FROM WOLF–RAYET STARS. Cannon, C. J. (Univ. of Sydney). Astron. Astrophys.; 34: No. 3, 387-391(Sep 1974).

A method of inversion is presented by which quantitative information may be obtained from Wolf–Rayet emission line spectra. Model atmospheres, with specified density, temperature, and velocity distributions were used to first compute various types of emission lines similar to those observed from Wolf–Rayet stars. These emission line spectra were then treated as the "observations" or data, and the inversion technique was applied to the data in an attempt to derive the above specified distributions. The ability of the method to generate convergence to the originally specified density, temperature, and velocity distributions gives some detailed insight into the information content of emission lines of this type. (auth)

30508 STUDY OF THE BLUE STRAGGLERS IN PRAESEPE, M 7, AND THE HYADES CLUSTER. Conti, P. S. (Joint Inst. for Laboratory Astrophysics, Boulder, CO); Hensberge, G.; van den Heuvel, E. P. J.; Strickland, D. J. Astron. Astrophys.; 34: No. 3, 393-399(Sep 1974).

Three blue stragglers, i.e., 40 Cancri in Praesepe, HD 162374 in M 7, and 68 Tauri in the Hyades Cluster were studied. For none of them were radial velocity variations found, indicating that a binary nature is unlikely. It is suggested—from colors, temperatures, and gravities as well as from evolutionary considerations—that 40 Cancri and possibly HD 162374 are population I blue horizontal branch stars and that 68 Tau is a star with hydrogen shell burning just beginning. (auth)

30509 ANALYTICAL STUDIES IN STELLAR EVOLUTION. II. On the Evolution of Rotating Stars in the log T_c – log ρ_c Plane from Main Sequence to Pre-Supernova Stage. Maeder, A. (Observatory, Geneva). Astron. Astrophys.; 34: No. 3, 409-414(Sep 1974).

The evolutionary tracks of the centers of rotating stars in the temperature–density plane were studied under the assumption of homologous changes. During a phase of central concentration, rotation acts in this plane like a reduction of the ratio $\alpha = (\partial \ln \rho / \partial \ln P)_T$, which appears in the equation of the state of stellar matter. Among the several consequences of this fact, rotation (even uniform on the main sequence) may reduce up to a factor 2 or more the value of the limiting mass between the occurrence of violent and nonviolent carbon ignition during evolution; a similar situation exists for the limit between helium flash and violent carbon ignition. Thus, rotation is able to affect considerably the branching towards the final stages of stellar evolution. The slopes of the tracks in the pre-helium flash and the pre-supernova stages are also discussed. The analytical developments show a result already obtained numerically by Sackmann and Weidemann (1972), i.e., that rotation allows the formation of much larger degenerate cores than in the absence of rotation. At a given central density, the luminosity of the star is highly increased, if the degree of differential rotation is important in the core. (auth)

30510 Li PRODUCTION IN $\alpha\alpha$ REACTIONS. Kozlovksy, B.; Ramaty, R. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 34: No. 3, 477-478(Sep 1974).

It is shown that the cross section for ^{7}Li production in $\alpha\alpha$ reactions is increased by about a factor of 2 due to the levels ^{7*}Li^{478keV} and ^{7*}Be^{431keV}. The cross section for ^{6}Li production, however, remains the same as calculated using detailed balance. The lines at 478 keV and 431 keV may link ^{7}Li production to feasible gamma-ray observations. (auth)

30511 OBSERVATIONS OF THE SHELL NEBULA NGC 3199. Deharveng, L.; Maucherat, M. (Observatory, Marseille). Astron. Astrophys.; 34: No. 3, 465-469(Sep 1974).

Monochromatic photographs in Hα and [N II] λ6584 of the shell nebula NGC 3199 are presented. Interferometric Hα radial velocities in this nebula show an expansion of 30 km s^{-1} around the exciting Wolf–Rayet star. The observations are interpreted as indicating ejection of material from a central Wolf–Rayet star against the interstellar gas. This nebula is compared with NGC 6888, and NGC 2359, for which a similar interpretation has been made. Physical parameters of NGC 3199 and its exciting Wolf–Rayet star are deduced. (auth)

30512 EXPERIMENTAL OSCILLATOR STRENGTHS FOR Ni I AND Ni II LINES. Heise, H. (Univ., Kiel). Astron. Astrophys.; 34: No. 2, 275-278(Aug 1974).

Relative oscillator strengths of 59 Ni I and 15 Ni II lines were determined from emission measurements with a high current electrical arc burning in an argon atmosphere. Introducing a small admixture of nickel chloride into the center of the arc, spectra of nickel could be observed end-on. A slight temperature variation along the axis, caused by a nonuniform nickel density, was carefully investigated and taken into account. Using the absolute oscillator strengths of 5 resonance lines of Ni I which recently had been measured by Marek (1972) with the phase-shift-method, the relative f-values could be brought to a new reliable absolute scale. The Ni II-values were related to the Ni I by the aid of the Saha-equation and electron density measurements. (auth)

30513 CEPHEID NATURE OF π PsA. Janot-Pacheco, E. (Universidade de Sao Paulo, Brazil). Astron. Astrophys.; 34: No. 2, 325-326(Aug 1974).

π PsA figures in the latest edition of the General Catalogue of Variable Stars by Kukarkin et al. (1970) as a Cepheid variable. Photoelectric five-color (Lick's UVBGR) measures taken at the ITA Astronomical Observatory, S. José dos Campos, Brazil, showed no variability within a few hundredths of magnitude in light and color. (auth)

30514 SIMILARITIES IN THE SPECTRA OF THREE SOUTHERN PECULIAR EMISSION LINE STARS WITH INFRARED EXCESS: HD 45677, HD 87643, AND GG CARINAE (HD 94878). Swings, J. P. (Univ., Liege). Astron. Astrophys.; 34: No. 2, 333-334(Aug 1974).

P Cygni profiles of the Balmer lines, sharp [Fe II] and [O I] emission lines, and diffuse or double Fe II emissions are characteristic of all three objects. The Fe II doubling in the spectrum of GG Car is presumably due to the presence of a thin equatorial ring rotating around the object, as suggested for HD 45677. (auth)

30515 SPECTROGRAPHIC OBSERVATIONS OF STARS IN CARINAE. Vreux, J. M. (Univ., Liege); Andrillat, Y. Astron. Astrophys.; 34: No. 2, 313-315(Aug 1974). (In French).

Spectra of Of stars located in the sky near η Carinae have been obtained on IIaO (12 Å mm^{-1}) and 103aF (31 Å mm^{-1}) plates. Differences with the descriptions of Walborn are outlined for HD 93129 A (N V $\lambda\lambda$4604–4620 absorptions stronger than He II λ4542; sharp absorption component in the center of He II λ4686 emission; emission on the red side of N V λ4604 definitely present and stronger than N III $\lambda\lambda$4634-40-42), HD 93161 A and B (separate spectra have been obtained for each star: they are clearly different), HD 93222 (variations have been observed in the profiles of Hβ and Hγ). The structure of the Ca II interstellar lines in the spectra of most of the Of stars observed is also outlined: double or multiple components have been detected. (auth)

30516 UBV PHOTOMETRY AND ORBITAL ELEMENTS OF V 453 CYGNI. Wachmann, A. A. (Hamburg Observatory). Astron. Astrophys.; 34: No. 2, 317-323(Aug 1974).

V 453 Cyg is among those early B-type systems most favorable for the determination of fundamental parameters. Being a member of the relatively young cluster NGC 6871 it is a very massive ($17 + 13\ M_\odot$), double-line and detached eclipsing binary. The apsidal motion ($U = 71^a$) is well established and both B 0,5 components show non-synchronous rotation. About 2000 observations in each color B and V obtained in a ten year observing period led to new photometric orbital elements. Additional 650 U observations and the fact that the secondary minimum is a total one permitted us by way of the Q-method to derive independent absolute $M_V = -4.1$ and -3.2. They agree with those derived by combining the photometric and spectroscopic parameters. The apsidal motion coefficient log $\bar{k}_2 = -2.2$ turned out to be very small and possibly points to evolution and to an age of about 9×10^6 years. (auth)

30517 EFFECTS UPON PERIOD RATIOS OF CEPHEID MODELS FROM ARTIFICIAL CHANGES IN OPACITY AND MEAN

MOLECULAR WEIGHT. Petersen, J. O. (Univ. of Copenhagen). Astron. Astrophys.; 34: No. 2, 309-311(Aug 1974).

The effects upon period ratios of stellar envelope models from changes in the assumptions for opacity and mean molecular weight are studied. Two period intervals are considered: $0.0 \lesssim \log \Pi_0$ (days) $\gtrsim 0.6$ and $-2.3 \gtrsim \log \Pi_0 \gtrsim -1.7$. The analysis of the long-period models shows that in this period interval mass determinations for double model Cepheids from period ratios depend very little upon the assumed opacities. In the short-period interval the effects are of the same order of magnitude as the changes found in the first model sequences, but in the opposite direction. (auth)

30518 INFRARED SOURCES IN SHARPLESS 157. Lunel, M. (Observatory, Lyon); Bergeat, J.; Sibille, F.; Lortet-Zuckerman, M. C. Astron. Astrophys.; 34: No. 2, 299-300(Aug 1974).

An infrared source has been detected at 2.2 μ in the bright knot and the compact radio source of Sh 2-157. The measured flux of 0.9 ± 0.15 f.u. roughly coincides with the western part of radio source A. The star which is assumed to be responsible for the H_α knot excitation is shown to contribute 0.05 f.u. at most. The detection of a second source on the eastern rim of the same radio source needs to be confirmed. (auth)

30519 LIGHT VARIATION OF THE AP STAR HD 25823. Rakos, K. D. (Univ. Observatory, Vienna). Astron. Astrophys.; 34: No. 2, 297-298(Aug 1974). (In German).

The UBV observations of Si-type Ap star HD 25823 reduced with the orbital period of 7.227 days show that rotation and revolution of this spectroscopic binary are synchronized. The amplitudes of the light curves are 0.03m for V and B and 0.045m for the U spectral region. They can be induced by small temperature and effective gravity variations over the stellar surface. The minimum of Si line strength coincides with maximum light and therefore the changes in Si/H ratio cannot be the cause of the light variations. (auth)

30520 AMPLITUDES OF POPULATION I CEPHEIDS IN THE GALAXY AND M 31. van Genderen, A. M. (Leiden Southern Station, Broederstroom, South Africa). Astron. Astrophys.; 34: No. 2, 279-284(Aug 1974).

A new period-amplitude diagram of over 250 galactic Population I Cepheids is constructed from data presented by Schaltenbrand and Tammann (1971) and compared with that of M 31. Contrary to those authors (1970) it is supposed that real differences exist between the diagrams for these two galaxies and the corresponding diagrams for Magellanic Clouds. The dip seen in the upper envelope between log P = 0.85 and 1.05, which lies just above the "zone of avoidance," is discussed. The amplitude–amplitude diagrams B against V and B against U show that slightly different mean ratios exist for Cepheids with blue amplitudes <1.5 mag and those with larger amplitudes. The possibility that this difference has arisen from the number of terms employed in the Fourier analysis is discussed. (auth)

30521 CARBON AND IRON ABUNDANCES FOR THIRTY F AND G TYPE STARS. Hearnshaw, J. B. (Observatory, Paris). Astron. Astrophys.; 34: No. 2, 263-274(Aug 1974).

The carbon and iron abundances have been measured in thirty dwarfs and subgiants of spectral type about F6 to K0, from differential analysis of the CH and Fe I spectra, using line blanketed model atmospheres. The iron-poor stars are found to have carbon overdeficiencies; the iron-rich ones, carbon overabundances. Approximately, $[C/H] = \frac{3}{2}[Fe/H]$ for stars in the range $-0.7 < [Fe/H] < +0.4$. Some tentative evidence is presented indicating that the oxygen abundances are not overdeficient relative to carbon in carbon-poor stars; they may be underdeficient. As a by-product of this work, a new empirical temperature calibration of the β index is presented for F-type stars. (auth)

30522 EFFECTS OF CHANGES IN THE OPACITY ON MAIN-SEQUENCE AND EVOLVED MODELS. Sackmann, I. J. (California Inst. of Tech., Pasadena). Astron. Astrophys.; 34: No. 2, 241-254(Aug 1974).

Models have been computed for 1.0 and $10M_\odot$ main-sequence stars, for the evolved Sun, and for evolved models of a 10 $M_\odot$ star from the main sequence up to the carbon flash to investigate the effects of opacity. For these, opacity variations in the photosphere and in the outer envelopes of stars as suggested by the recent 1970 Cox and Stewart and Watson opacity tables have been assumed. In particular, for the evolved Sun, the increased envelope opacity of the 1970 Watson tables lowers the surface hydrogen and metal abundance, placing the solar composition in the range of X = 0.693, Z = 0.021 to X = 0.739, Z = 0.014. The dependence on opacity of the luminosity, the radius and the effective temperature is explored parallel to the computations with a simplified phenomenological approach. A "two-step" model is found to be able to produce qualitative predictions of the shift in the HR diagram produced by an arbitrary opacity change. The location of the Hayashi line in the HR diagram (10 $M_\odot$) is nearly unaffected by changes of envelope opacities, but shifted to the left by photospheric opacity decreases; in particular, for the new Cox and Stewart opacities, it is shifted by 0.025 in $\log T_{eff}$ to the left. Increases in envelope opacities increase the length of the loops (for 10 $M_\odot$) and tend to produce a clustering of the loop stars in the right hand portion of the loops. Increases in envelope opacities allow a slightly larger and earlier enrichment of helium in the surface layers; in particular, following carbon ignition with Watson opacities for a 10 $M_\odot$ star, there is a helium enrichment of $\Delta Y = +0.07$ in the surface layers. Increases in envelope opacities enhance the strength of the carbon flash. (auth)

30523 PULSATION PROPERTIES OF THE β CEPHEI STARS. Lesh, J. R.; Aizenman, M. L. (Joint Inst. for Laboratory Astrophysics, Boulder, CO). Astron. Astrophys.; 34: No. 2, 203-210 (Aug 1974).

A linear pulsation analysis has been carried out for 10 and 15 $M_\odot$ models with two chemical compositions – X = 0.72, Z = 0.03; and X = 0.69, Z = 0.06 – at several stages in their early post-main-sequence evolution. The computed periods, pulsation constants, and secular period changes are compared with observed quantities for the classical β Cephei stars. Although the evidence does not point unambiguously to a single mode of pulsation, it would appear that harmonic oscillations are favored over the fundamental mode. (auth)

30524 PROPERTIES AND EVOLUTION OF BQ[ ] STARS. Ciatti, F.; D'Odorico, S.; Mammano, A. (Univ., Padua). Astron. Astrophys.; 34: No. 2, 181-186(Aug 1974).

Spectroscopic observations of MWC 17, MWC 349, HD 45677 and HD 51585 obtained at Asiago ($\lambda\lambda$ 3800–10900 Å) are used with the infrared and radio data to define a two component model of BQ[ ] stars. An evolutionary sequence where some BQ[ ] stars might evolve into a kind of planetary nebulae is suggested. (auth)

30525 SPECTROSCOPIC BINARIES AND COLLAPSED STARS. II. Systems with Small Mass Functions. Trimble, V. (Univ. of Maryland, College Park). Astron. Astrophys.; 34: No. 3, 461-462(Sep 1974).

In response to a suggestion by Suntantyo, a list of 18 single-line spectroscopic binaries having evolved OB primaries, periods less than 20 days, and mass ratios less than 0.3 is presented. None of them falls within the error box of any unidentified 3U x-ray source, although they are of the same general type as systems previously identified as x-ray emitters. (auth)

30526 RADIO SOURCES AND THE AQUILA STELLAR RING COMMENT ON A PAPER BY J. ISSERSTEDT. Baars, J. W. M. (Netherlands Foundation for Radio Astronomy, Dwingeloo). Astron. Astrophys.; 34: No. 3, 459-460(Sep 1974).

The association of radio sources with the Aquila "stellar ring" as presented by Isserstedt is discussed. It is pointed out that Isserstedt's conclusions are based on an incorrect use of the Master List of Radio Sources, a compilation of radio source data by Dixon. It is concluded that the density of radio sources in the area of the stellar ring is normal. In particular there is no excess of radio sources at 4.5° from the center of the stellar ring. Thus there is no reason to invoke an old supernova remnant at 18 pc radius from the center of the stellar ring. There are 4 sources from the Ohio catalog, three of which are also in 4 C, plus one 4 CP source, which lie within 7 arcmin from the locus of the ring. All have a spectral index typical of extragalactic radio sources. (auth)

30527 ANGULAR DIAMETER OF TX PISCIUM FROM LUNAR OCCULTATIONS. de Vegt, C. (Hamburg Observatory). Astron. Astrophys.; 34: No. 3, 457-458(Sep 1974).

An occultation reappearance of the carbon-star TX Psc. was observed on 18th August 1973 with the 60 cm refractor of the Hamburg observatory using an offset-photometer especially designed for lunar occultation work. An angular diameter of 0.0080'' ± 0.001'' is determined for a uniformly illuminated stellar disk. The comparison with a previous diameter determination by Lasker et al. shows a satisfactory agreement. (auth)

30528 INFLUENCE OF THE VARIATION OF THE CONVECTIVE ZONE BOUNDARIES ON THE SECULAR STABILITY OF STARS. Gabriel, M.; Noels, A. (Univ., Liege). Astron. Astrophys.; 34: No. 3, 455-456(Sep 1974).

The variation of the mass extension of convective regions, due to a secular perturbation, was taken into account in 3 secular stability problems: (1) Gravitational contraction of a 1.1 $M_\odot$ star, (2) helium burning phases of an 8 $M_\odot$ star, and (3) static

models of a 9 $M_\odot$ star during the central helium burning phase. In all 3 cases, the effect appears to be very small. (auth)

30529 SPACE OSCILLATIONS OF STELLAR NONRADIAL EIGENFUNCTIONS. Scuflaire, R. (Univ., Liege). Astron. Astrophys.; 34: No. 3, 449-451(Sep 1974).

It is generally believed that the g^- modes of nonradial oscillations of a star may oscillate only in convective zones, and that the g^+ modes may oscillate only in radiative zones. Whereas the first statement may be proved quite generally, the second one is true only in the inner part of the star. With this restriction it is valid also for p modes. (auth)

30530 TEST FOR THE EXISTENCE OF DUST IN SUPERNOVA ENVELOPES. Friedjung, M. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 34: No. 3, 419-422(Sep 1974).

A study of the intensities of Ca II emission lines observed in Type I supernova spectra suggests that the influence of reddening due to dust in the ejected envelope, is not very important in the early stages after the initial explosion. (auth)

30531 POLARIZATION OF LIGHT FROM THE PECULIAR Be STAR MWC 349. Elvius, A. (Stockholm Observatory). Astron. Astrophys.; 34: No. 3, 371-374(Sep 1974).

The emission line object MWC 349 has been found to show a high degree of polarization, the wavelength dependence of which is similar to that of VY Canis Majoris and of some Be stars and red variables but different from the normal wavelength dependence of interstellar polarization. Two possible interpretations of the high degree of linear polarization are considered, namely (1) multiple scattering of light from the bright star in a flattened circumstellar dust cloud; (2) a small bright asymmetric reflection nebula. (auth)

30532 NEW PLASMA-OVEN OF ASTROPHYSICAL INTEREST. Application to the Measurement of Ar–I transition Probabilities. von Specht, J. (Goettingen Univ. Observatory, Ger.). Astron. Astrophys.; 34: No. 3, 363-370(Sep 1974).

A plasma-oven is described which produces a stationary, homogeneous plasma in the astrophysically interesting temperature range of 3000 to 8000°K. With the plasma-oven, containing argon with small admixtures of hydrogen, Ar–I transition probabilities were determined. The Ar–I transition probabilities show no detectable dependence on the electron density, suggesting that there are no noticeable departures from LTE. The results are compared with other experiments and a detailed discussion of the errors is given. (auth)

30533 MASS LOSS FROM EARLY TYPE STARS. Chiosi, C.; Nasi, E. (Univ., Padua). Astron. Astrophys.; 34: No. 3, 355-362 (Sep 1974).

Evolutionary models of massive Pop I stars, 20 and 40 $M_\odot$ with initial chemical composition given by the mass abundances, X = .602, Z = .044, are computed from the main sequence up to the core He-ignition stages taking into account mass loss. The rate of mass loss is according to the relation $dM/dt = K(LR/M)$ where the constant K is so as to give some imposed rates in the main sequence stage. The appearance of semiconvective instability is also taken into account and it is found that its mass extension strongly depends on the main sequence rate. An attempt is made to compare these results with the losing mass OB stars and, in the assumption that actually OB stars might lose mass during the core H-burning stages, it is also suggested a possibility of determining their mass and that of their parent stars. (auth)

30534 RAPIDLY ROTATING STARS WITH OPTICALLY THIN STELLAR WINDS. Marlborough, J. M. (Dominion Astrophysical Observatory, Victoria, British Columbia); Zamir, M. Astrophys. J.; 195: No. 1, 145-155(1 Jan 1975).

The analysis of Cassinelli and Castor, concerning the role of the radiation field in the heating, cooling, and transfer of momentum to the atmospheres of early-type stars, is extended to the case of rapidly rotating stars in general, and of Be stars in particular. The general equations for steady flow are presented and the solution discussed for flow in the equatorial plane and in the region near the pole under the assumptions of an optically thin wind and radially streaming radiation. Limiting values for the ratio of velocity of escape to mean thermal speed at the sonic point are obtained if transonic flow is to occur. The observational evidence presently available is considered and is shown to support the theoretical predictions. (auth)

30535 SPHERICAL ACCRETION NEAR THE EDDINGTON LUMINOSITY. Maraschi, L.; Reina, C.; Treves, A. (Univ., Milan). Astron. Astrophys.; 35: No. 3, 389-392(Oct 1974).

The problem of steady accretion of a compact star in spherical symmetry is considered taking into account the radiation pressure due to Thomson scattering and neglecting the internal pressure of the infalling gas and its heating by the outgoing radiation. The transfer of photons is treated as a diffusive-convective process. The electric field deriving from the difference of forces acting on electrons and protons is also given. The problem leads to a quasilinear second order equation for the velocity field, which can be solved analytically at large distances from the star where convection is negligible. The velocity, density, and luminosity profiles in the vicinity of the star are obtained numerically for different values of the total luminosity. In particular it is found that at the surface of the star the infall velocity tends to about one tenth of the keplerian velocity for luminosities approaching the Eddington limit. (auth)

30536 PHOTOMETRIC ORBIT OF KP AQUILAE. Ibanoglu, C.; Guelmen, O. (Ege Univ., Izmir, Turkey). Astron. Astrophys.; 35: No. 3, 487-490(Oct 1974).

The eclipsing binary KP Aql was observed photoelectrically in yellow and in blue light at the Ege University Observatory. A total of 726 observations were obtained in each color. 13 epochs of minima were obtained and new light elements were derived. A double period for this system is suggested. The eclipses are complete, and the solution for the orbital elements indicates that the two components are of roughly equal size and brightness. (auth)

30537 ECCENTRIC ORBIT OF PV CASSIOPEIAE. Ibanoglu, C. (Ege Univ., Izmir, Turkey). Astron. Astrophys.; 35: No. 3, 483-486(Oct 1974).

Photoelectric observations of the eclipsing binary PV Cas were carried out in blue and in yellow bands. PV Cas is an Algol-type system with partial eclipses, the primary being a transit. The period of the system is 1.75046986d which is approximately double that given by Geyer. The secondary minimum is displaced from one-half period and the durations of the eclipses are nearly equal. From this the eccentricity of the orbit and the longitude of the periastron were calculated and are presented. New orbital elements were derived using the method of Kitamura. (auth)

30538 PERIOD OF THE SPECTRUM VARIABLE SIGMA ORI E. Thomsen, B. (Aarhus Univ., Denmark). Astron. Astrophys.; 35: No. 3, 479-481(Oct 1974).

A photoelectric index of the He I line λ 4471 was measured for the spectrum-variable helium-rich star σ Ori E in order to determine the period. The best fit to the data is achieved with a period of 6.0d although a short period of 29 hr or 21 hr is possible. (auth)

30539 UBV LIGHT CURVES OF HZ HERCULIS: THE 35-DAY CYCLE BEHAVIOR. Chevalier, C. (Observatoire de Meudon, France); Ilovaisky, S. A. Astron. Astrophys.; 35: No. 3, 407-415(Oct 1974).

Between March and October 1973 standard UBV photoelectric observations of HZ Herculis were made on 53 nights using the 60 cm and 80 cm reflectors at Haute Provence Observatory. The data were folded using the 1.700165 d x-ray period and divided into seven groups of U, B, V, U–B, and B–V light curves showing the changes taking place in the course of the 35 d x-ray cycle of Hercules X-1. The main characteristics of these light curves are: 1) the presence of a 0.25m deep secondary minimum near orbital phase $\phi = 0.5$ (with no color change) during the x-ray "ON" period; 2) very rapid color index changes taking place at egress especially during the "ON" period; 3) an ultraviolet peak near $\phi = 0.5$ present in the middle of the "OFF" period, amounting to 0.5m in the U filter and shifting to earlier phase with time, accompanied by short-lived "bumps" and "shoulders" with associated color changes in the ascending and descending branches; 4) a mirror-image symmetry in the light curve with respect to day 23 after turn-on (middle of "OFF" phase). The modulation of the light curve amplitude in the course of the 35 d cycle amounts to 53% in the U filter, 37% and 34% in the B and V filters respectively. Thus the U–B index undergoes marked changes throughout the cycle while the B–V index shows little dependence on 35 d phase. (auth)

30540 RAPID LINE VARIABILITY. II. Search for *Hβ* Variability in 5 Ap, Delta Del, and Am Stars. Williams, W. E.; Frantz, R. L.; Breger, M. (Univ. of Texas, Austin). Astron. Astrophys.; 35: No. 3, 381-383(Oct 1974).

After reports in the literature of possible rapid line variations in several Ap and other types of stars, rapid photoelectric scans of three more Ap stars, one Am star, and one δ Del star were obtained. No variations were found in the shape of the line profiles or equivalent width variations greater than the expected observational errors of 2% for any of the stars observed. (auth)

30541 EFFECT OF MASS-FORMULA ON THE R-PROCESS PRODUCT. Kritchman, E. M.; Kozlovsky, B. Z.; Shaviv, G. (Tel-Aviv Univ., Israel). Astron. Astrophys.; 35: No. 3, 345-351(Oct 1974).

The new mass formula derived by Garvey et al. (1969) was examined by comparing the r-process abundance prediction and observation. The various relevant assumptions are stated. It was concluded that with this formula the prediction of the r-process conforms best with observation. A correction to the mass formula that improves the agreement further is proposed. (auth)

30542 PHOTOELECTRIC SPECTROPHOTOMETRY OF PLANETARY NEBULAE. Perinotto, M. (Astrophysical Observatory of Arcetri, Florence). Astron. Astrophys.; 35: No. 2, 293-294(Oct 1974).

Photoelectric measurements of emission line intensities of eight planetary nebulae have been made at Lick Observatory with a scanner and the 36-inch Crossley reflector. The lines range from λ3727 [O II] to the 10938 Paschen line. The intensities are very similar to those obtained with the same equipment by Peimbert and Torres-Peimbert (1971) for the three nebulae in common. (auth)

30543 POLARIZATION OBSERVATIONS IN PRAESEPE. Markkanen, T. (Univ. of Helsinki). Astron. Astrophys.; 35: No. 2, 297-299(Oct 1974).

The polarization of light for seventeen stars in Praesepe has been measured. Its amount ranges 0.06 to 0.25%. The mean of the standard deviations of the amounts of polarization is ±0.02%. Assuming the polarization to be of interstellar origin, the lower limits of extinction and color excesses are estimated. The mean visual extinction is $A_V = 0.05$m and the mean color excess $E(B-V) = 0.015$m. The mean position angle of the polarizations of the stars observed is 55° with a scatter of ±9°. The direction fits well into the helical model of the local magnetic field. (auth)

30544 TIDAL EVOLUTION OF MASSIVE X-RAY BINARIES. Sutantyo, W. (Univ. of Amsterdam). Astron. Astrophys.; 53: No. 2, 251-257(Oct 1974).

The tidal evolution of known massive x-ray binaries is considered in order to explain why in most cases their orbits are nearly circular. Only the tidal interaction during the main-sequence life time of the primary (which is assumed to be a 20 $M_\odot$) is considered starting after the supernova explosion which produced the compact object. Assuming that at the final stage of the tidal evolution the orbit is circular and the orbital motion is synchronized with the rotation of the primary, a lower limit of the mass of the compact object can be determined. The mean viscosity required to circularize the orbit of Vela X-1 in a given time interval is at least one order of magnitude higher than for the other systems due to the large orbital period of this system; this may explain why the orbit of this system has not yet been circularized. Assuming the tidal evolution to take place in less than 5×10^6 years (the approximated age of the systems) the lower limit of the mean viscosity required to circularize the orbit of all systems, except Vela X-1, is about 10^{12} to 10^{14} g cm^{-1} s^{-1}. Such high viscosities can be produced by magnetic viscous forces if magnetic fields with a strength of a few gauss are present. (auth)

30545 ROTATION IN BINARY STARS. Levato, H. (Observatorio Astronomico, Buenos Aires). Astron. Astrophys.; 35: No. 2, 259-265(Oct 1974).

Rotational velocities and MK spectral types were determined for the primaries and secondaries of 59 visual binaries and for 88 spectroscopic and eclipsing binaries (Levato, 1974). With this material and the data found in the literature some rotational properties and the synchronism problem have been rediscussed. (auth)

30546 DYNAMICAL EVOLUTION OF SIMULATED STAR CLUSTERS. I. Isolated Models. Aarseth, S. J. (Institute of Astronomy, Cambridge, Eng.). Astron. Astrophys.; 35: No. 2, 237-250(Oct 1974).

The dynamical evolution of seven isolated cluster models which have been studied by direct N-body methods. Although some features of these calculations have been described before, the present analysis is more comprehensive and includes additional models. It is confirmed that core contraction also leads to the formation of a dominant central binary in equal-mass systems, on a time-scale of 30–40 crossing times as compared to about 10 crossing times for 250 particles with different masses. Most of the energy absorbed by close binaries goes into cluster expansion rather than escape and the overall evolution of the mass spectrum models slows down significantly when measured by the initial crossing time. Expansion of the inner cluster region eventually leads to the formation of hierarchical triple systems which are internally stable as long as the outer pericentre distance does not become too small. The computed escape rates compare well with the theory of Hénon (1969) when the masses are different but the equal-mass systems eject more particles than expected. The escape process itself is mainly connected with discrete events and the mean kinetic energy carried away by escaping particles is in substantial agreement with the theoretical prediction for both equal and different masses. (auth)

30547 HIGH-RESOLUTION RADIO INTERFEROMETRIC OBSERVATIONS OF THE PLANETARY NEBULAE NGC 40, NGC 6543, AND NGC 6720. George, D.; Kaftan-Kassim, M. A.; Hartsuijker, A. P. (Sterrewacht, Leiden). Astron. Astrophys.; 35: No. 2, 219-224(Oct 1974).

Radio brightness maps of the planetary nebulae NGC 40, NGC 6543, and NGC 6720 are presented. The resolution is 6'' × 6'' cosec δ and the wavelength 6 cm. Densities are derived from simple cylindrical models. Estimates of the total ionized masses are obtained. Electron temperatures are calculated for NGC 6543 and NGC 6720. The temperature obtained for NGC 6720 from the radio data is low compared to that derived from the forbidden line ratios. (auth)

30548 Q VALUES OF MODELS IN THE MAIN-SEQUENCE BAND. Jorgensen, H. E.; Petersen, J. O. (Copenhagen Univ. Observatory). Astron. Astrophys.; 35: No. 2, 215-218(Oct 1974).

Pulsation constants Q_0 and Q_1 for models in the main-sequence band and near to it were studied, assuming different boundary conditions. Different masses and chemical compositions are investigated. It was found to be justified to use $Q_0 = 0.0335$ to derive masses of δ Scuti stars. The period ratios however are only insensitive to the interior boundary conditions, to a high degree of accuracy, for periods larger than 0.08d; the structure of the central parts must be taken into account before using period ratios for models near the zero-age line in the period range 0.046d to 0.08d. (auth)

30549 STARK BROADENING OF ISOLATED LINES IN THE IMPACT APPROXIMATION: EXPRESSION OF THE QUADRUPOLE TERM FOR COMPLEX ATOMS. Sahal-Brechot, S. (Observatoire de Meudon, France). Astron. Astrophys.; 35: No. 2, 319-321(Oct 1974).

The angular factor of the quadrupole term appearing in the semi-classical expression of the width of a line broadened by electron (or ion) impact is calculated in L–S coupling for complex atoms, using the Fano–Racah Algebra. (auth)

30550 ORBIT AND NATURE OF THETA 2 ORIONIS A. G. Aikman, C. L.; Goldberg, B. A. (Dominion Astrophysical Observatory, Victoria, B. C.). J. Roy. Astron. Soc. Can.; 68: 205-212 (Aug 1974).

A new orbit, based on a corrected period, is derived for this spectroscopic binary star from new and published radial velocities covering the period of 1903-1973. Evidence for a possible change in period, the presence of a secondary spectrum and the existence of any possible spectroscopic peculiarities are each discussed in relation to the proposed identification of this star with the x-ray source 2U 0526-06. (auth)

30551 X-RAY LINES FROM ACCRETING BLACK HOLES. Meszaros, P. (Univ. of Cambridge, Eng.). Astron. Astrophys.; 35: No. 2, 171-176(Oct 1974).

The x-ray emission line spectrum of black holes surrounded by accretion disks is considered. For steady-state disks, the expected line strengths, equivalent widths and broadening are calculated. This is done for the Lα line of S^{+15}, using a representative set of disk parameters, and for the intercombination and forbidden lines of Fe^{+24}, for a range of disk parameter. The values predicted differ from those of other models of x-ray sources and are such that experimental detection appears feasible. (auth)

30552 INTERPRETATION OF 1 MONOCEROTIS. Desikachary, K. (Univ. of Western Ontario, London). Astron. Astrophys.; 35: No. 2, 303-305(Oct 1974).

Millis' (1973) observations of 1 Monocerotis have been reanalyzed to show that the natural frequencies $\nu_0 = 7.34618$ c/d ($P_0 = 0.136125$d), $\nu_1 = 2\nu_0 = 14.69236$ c/d ($P_1 = P_0/2 = 0.068062$d) and the combination frequencies $\nu_0 \pm \nu_L$ and $\nu_1 \pm \nu_L$, where $\nu_L = 0.12907$ c/d ($P_L = 7.7477$d), are excited. It is suggested that the combination frequencies may arise from the tidal interaction with the pulsating star of a faint orbital companion of period P_L. (auth)

30553 DISTANCE AND REDDENING OF THE MASSIVE H II REGION NGC 3603. Moffat, A. F. J. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 35: No. 2, 315-317(Oct 1974).

Photoelectric U BV photometry of ten stars in the central region of NGC 3603 is used to revise the previous photographic photometry of Sher (1965). A photometric distance of 8.1 ± 0.8 kpc is derived, in agreement with kinematic estimates. The interstellar reddening is homogeneous: $E_{B-V} = 1.32 \pm 0.04$ (s.d. from 17 stars). There is no increase of reddening with increasing intrinsic stellar luminosity, contrary to the findings of Reddish (1967). NGC 3603 contains O 5–6 stars which require a somewhat smaller than usual value of the ratio E_{U-B}/E_{B-V}, namely 0.70, to allow a derivation of intrinsic colors in the two-color diagram. (auth)

30554 SYNTHESIS OF LIGHT CURVES OF SEMI-DETACHED BINARY STARS. II. Pustylnik, I. (Inst. of Physics and Astronomy, Tartu). Postepy Astron.; 22: No. 4, 329-344(Dec 1974). (In Polish).

It is shown that the application of the von Zeipel theorem to the external layers of stellar atmospheres is not sufficiently justified. A new formula describing the variations of the integral radiative flux over a surface of a nonspherical star is deduced. (auth)

30555 TRANSITION RADIATION: A POSSIBILITY OF A NEW RADIATION MECHANISM IN ASTROPHYSICS. Jarzebowski, T. (Univ., Wroclaw). Postepy Astron.; 22: No. 4, 275-282(Dec 1974). (In Polish).

Physical principles of the so-called transition radiation are presented. Influence of that mechanism on the formation of the background radiation spectrum and T Tauri spectra in the ultraviolet and x-ray regions are discussed. (auth)

30556 COLLISION STRENGTHS FOR THE ELECTRON-IMPACT EXCITATION OF CERTAIN HIGHLY-IONIZED HELIUM-LIKE IONS. Jones, M. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 211-227(Nov 1974).

Collision strengths for transitions involving singly-excited states with principal quantum numbers $n \leq 2$ in the astrophysically-important helium-like ions SiXIII, CaXIX, and FeXXV are given. The collision strengths were evaluated in both LS-coupling and intermediate-coupling using the distorted wave method. Large angular momentum contributions to collision strengths for electric dipole transitions among the $n = 2$ levels are evaluated in the Coulomb–Bethe approximation. Possible magnitudes of errors in the intermediate-coupling collision strengths are discussed. (auth)

30557 TEN MICRON OBSERVATIONS OF GLOBULAR CLUSTERS. Cohen, M.; Fawley, W. M. (Univ. of California, Berkeley). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 31P-33P(Nov 1974).

Scans of eight globular clusters and integrations on the cores of seven have revealed no significant sources at 10 μ. (auth)

30558 SPECTROSCOPY OF SUPERNOVA REMNANTS. Danziger, I. J.; Dennefeld, M. (European Southern Observatory, Santiago). Astron. Astrophys.; 36: No. 1, 149-152(Nov 1974).

A list of approximately 55 emission lines identified in the supernova remants N 63 A (LMC), RCW 86, and RCW 103 are presented with rough estimates of the relative strengths. The presence and strengths of these lines are in qualitative agreement with expectations of the theory of isothermal shock-heating and cooling of the interstellar medium. The presence of lines of [Ca II] is of particular interest. A discussion of spectra of N 120, the northern extension of N 49, RCW 89, Kesteven 45 and N 57, reveals that the first four are supernova remnants, and the last more probably a photoionized H II region. (auth)

30559 CONVECTION IN THE PHOTOSPHERE OF ARCTURUS. Dravins, D. (Lund Observatory, Sweden). Astron. Astrophys.; 36: No. 1, 143-145(Nov 1974).

Convective motions in stellar atmospheres involve hot gases that rise, cool off and then sink back. High-excitation spectral lines are preferentially formed in the hot, rising and thus locally blue-shifted elements while low-excitation lines are preferentially formed in the cooler, sinking and red-shifted elements. By comparing accurate wavelengths for spectral lines in Arcturus (α Boo, K 2 IIp) with laboratory values, a relation is found, such that high-excitation lines are systematically blue-shifted relative to low-excitation lines. This relation is very similar to the one previously known for the Sun and is interpreted as the existence of convection cells, similar to the solar granulation, in the photosphere of Arcturus. (auth)

30560 FLUORESCENCE LINES EXCITED BY THE Mg II RESONANCE DOUBLET. Greve, A. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 36: No. 1, 135-137(Nov 1974).

Possible fluorescence lines, excited by absorption lines coinciding with the Mg II resonance line emission, are listed. It is pointed out that two further absorption lines of Fe I and Zr I may possibly affect the shape of the Mg II 2795.52 Å line of α ORI, since in the visible spectrum of K_e, M_e and N stars a fluorescence counterpart of these lines is observed with reasonable strength. (auth)

30561 NONRADIAL OSCILLATIONS OF CONDENSED POLYTROPES. Scuflaire, R. (Univ., Liege). Astron. Astrophys.; 36: No. 1, 107-111(Nov 1974).

In the adiabatic nonradial oscillations of condensed polytropes, the f mode and the first p and g modes show unusual behavior characterized by the appearance of extra nodes. It is shown that these modes may be interpreted as waves of mixed character, of the internal gravity type in the central regions and of the acoustic type in the external ones. (auth)

30562 NATURE OF THE 10 MICRON SOURCE IN M15. Caloi, V.; Panagia, N. (Laboratorio di Astrofisica Sapziale, Frascati, Italy). Astron. Astrophys.; 36: No. 1, 139-141(Nov 1974).

The possible nature of the 10 μ source in M 15 has been investigated and some physical parameters have been derived. It could be a planetary nebula in the early formation. (auth)

30563 INFRARED EMISSION OF DUST HEATED BY RANDOMLY DISTRIBUTED STARS. Baschek, B.; Traving, G.; Wehrse, R. (Univ., Heidelberg). Astron. Astrophys.; 36: No. 1, 147-148(Nov 1974).

Theoretical infrared spectra of dust heated by the radiation of randomly distributed stars are discussed, using the nearest star approximation in order to calculate mean intensities. These spectra are considerably flatter than emission with a uniform dust temperature. (auth)

30564 SPECTROSCOPIC AND PHOTOMETRIC INVESTIGATION OF THE A 2 Ia-O STAR HD 160529. Wolf, B. (European Southern Observatory, Santiago); Campusano, L.; Sterken, C. Astron. Astrophys.; 36: No. 1, 87-98(Nov 1974).

A simultaneous photometric (uvby) and high dispersion (12Å/mm) spectroscopic investigation of the extreme galactic A-supergiant HD 160529 has been carried out. From large radial velocity variations, of an amplitude of 40 km/s, and from a variable splitting of the Ti II-, Fe II- and Cr II-lines of a maximal separation of 42 km/s, the existence of very pronounced time- and depth-dependent non thermal photospheric velocity fields was inferred. The measured intensity variations of the absorption lines of about 20% and the considerable photometric variations with an amplitude of 0.27 in y and of 0.18 in (u−v) are explained by the action of these velocity fields. It is suggested that such variable velocity fields likewise provide an explanation for correlated line intensity and radial velocity-variations. The mass flux, coupled with the velocity field, is supposed to produce a chromosphere in HD 160529 by mechanical energy dissipation. The detected emission features of Hα, Hβ, and of the Fe II-lines at $\lambda\lambda$ 5991, 6432 and 6516 (these Fe II-lines are known to occur in nova like variables in emission), as well as the absorption line He λ 5876 are considered as chromospheric in origin. A variability of the Hβ-emission component, with changes from an inverse to a normal "P-Cygni" type profile, was found. The strong coupling of the line splitting and the intensity variations of the Fe II-emission lines was investigated. (auth)

30565 BINARY SYSTEMS 14 CEPHEI AND 2 LACERTAE. Hilditch, R. W. (Saint Andrews Univ., Eng.). Mon. Notic, Roy. Astron. Soc.; 169: No. 2, 323-329(Nov 1974).

New spectroscopic observations are presented and improved orbital elements are derived for these two early-type SB2 systems. Fourteen Cephei appears to be evolved and similar to LY Aurigae but viewed at a lower inclination. The primary component of 2 Lacertae is near the phase of core hydrogen exhaustion, and both compounds of this binary obey the mass–luminosity relation. (auth)

30566 MASSIVE BLACK HOLES AS GRAVITATIONAL LENSES. Silvestro, G. (Univ. of Turin). Astron. Astrophys.; 36: No. 1, 41-48(Nov 1974).

A dense stellar system containing a massive collapsed object is considered. When an orbiting star goes behind the black hole, gravitational deflection of light in the hole's gravitational field may considerably increase its apparent luminosity, giving rise to a short light pulse. Such a "gravitational focusing" effect is analyzed for a Newtonian spherically symmetric stellar system containing at its center a Schwarzschild black hole; counting rate, pulse length and amplitude distributions are evaluated assuming a steady-state distribution of stars in a characteristic region near the black hole. The effect, which depends mainly on the fraction of collapsed mass in the system, appears to provide a possible observational test for massive black holes. Its detection should be feasible with present techniques for a compact globular cluster containing a collapsed object of some thousandths the total mass. (auth)

30567 HELIUM-TO-HYDROGEN RATIO IN B STARS, AS DETERMINED FROM PHOTOELECTRIC OBSERVATIONS OF A NARROW-BAND INDEX OF THE He I λ 4026 LINE. Nissen, P. E. (Aarhus Univ., Denmark). Astron. Astrophys.; 36: No. 1, 57-68 (Nov 1974).

Photoelectric observations of a narrow-band index, I(4026), of the He I λ 4026 absorption line have been carried out with an echellespectrophotometer for 148 main-sequence B-type stars. Ninety-six stars are bright field stars, 35 belong to the Scorpio-Centaurus association and 17 stars to the young cluster NGC 6231 in the Sagittarius spiral arm. The color index difference $[c_1]$, the H_δ index, and I(4026) are computed for LTE-model atmospheres

as functions of effective temperature, surface gravity, and the number ratio between helium and hydrogen, $\epsilon(He) = N(He)/N(H)$. Comparison with the observations then yields these three parameters for each star. The analysis shows that any cosmic scatter of stellar atmospheric helium abundances is small, the rms scatter of $\epsilon(He)$ for field stars, that lie within 500 pc from the sun being smaller than 0.01, if a few anomalous stars are excluded. The differences of the mean helium abundances of the three groups of stars are: $\langle\epsilon(He)\rangle_{Sco\text{-}Cen} - \langle\epsilon(He)\rangle_{Field\ stars} = 0.000 \pm 0.004$, and $\langle\epsilon(He)\rangle_{NGC\ 6231} - \langle\epsilon(He)\rangle_{Field\ stars} = -0.017 \pm 0.007$. The absolute mean helium-to-hydrogen ratio for field stars is found to be $\epsilon(He) = 0.08$ with an estimated uncertainty of ± 0.015. A number of stars are found to be apparently helium weak in the sense that $\epsilon(He) < 0.03$. Four stars seem to have helium abundances in the range $0.04 < \epsilon(He) < 0.06$ and two stars are found to have helium abundances of the order of $\epsilon(He) = 0.12$. (auth)

30568 INSTABILITY OF TWO-COLOR CONTACT BINARIES. Hazlehurst, J. (Observatory, Hamburg). Astron. Astrophys.; 36: No. 1, 49-56(Nov 1974).

A condition is derived for the secular stability of a contact binary in which the components share a common convective envelope. For a large class of models, this stability condition can not be satisfied when the adiabatic constants of the two stellar convection zones differ by more than a certain small amount. A consequence is that the contact binary models of Biermann and Thomas, Moss and Whelan (1973) and Vilhu are unstable. The existence of such an instability may account for the distinct lack of short period ($P < 0.5$ days) eclipsing variables with β Lyrae type light curves. (auth)

30569 BINARY SYSTEM AS ERI. Refsdal, S.; Roth, M. L.; Weigert, A. (Observatory, Hamburg). Astron. Astrophys.; 36: No. 1, 113-122(Nov 1974).

The very accurate observations of the semidetached system AS Eri by Popper (1973) require a corresponding refinement of the theory of binary evolution to white dwarfs. Here the influence of chemical profiles and loss of angular momentum are discussed. The internal state of the present subgiant component and the future and past evolution of the system are discussed. The past evolution offers the problem that many possibilities are left for the initial conditions, the ranges of which are discussed. A loss of angular momentum since the onset of mass exchange is indicated. (auth)

30570 INTERACTION BETWEEN THE BARNARD LOOP NEBULA AND THE INTERSTELLAR MAGNETIC FIELD. Appenzeller, I. (Gottingen Univ., Ger.). Astron. Astrophys.; 36: No. 1, 99-105(Nov 1974).

New observations of the linear interstellar polarization of starlight are used to study the geometric structure of the interstellar magnetic field in the vicinity of the Barnard Loop Nebula in Orion. The observed complex field structure cannot be explained by a simple radial expansion of a conducting gaseous shell into an initially parallel field. A satisfactory fit of the observations can be obtained by assuming that the interstellar gas in Orion is suspended in an interstellar "magnetic pocket." It is suggested that the formation of the observed dense interstellar clouds and very young stars in the Orion aggregate is a result of the local structure of the interstellar magnetic field. (auth)

30571 MAGNETOHYDRODYNAMIC INSTABILITIES IN NEUTRON STARS. Chanmugam, G. (Louisiana State Univ., Baton Rouge). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 353-355(Nov 1974).

Tayler's result (Mon. Not. R. Astr. Soc.; 162: 17 (1973)) that strong enough magnetic fields may cause instabilities in neutron stars is extended by taking into account the possibility that the time scale of the perturbations is less than the nuclear relaxation time. It is found that the minimum field that might cause instability is much higher than that derived by Tayler. (auth)

30572 SPECTRUM OF THE SUPERGIANT EPSILON ORIONIS (BO Ia). I. Identifications, Equivalent-Widths, Line Profiles. Lamers, H. J. (Rijksuniversiteit, Utrecht). pp 15-34 of Studies on the Structure and Stability of Extended Stellar Atmospheres. Lamers, H. J. (ed.). Utrecht; Rijksuniversiteit (1974).

The visual spectrum of the supergiant star ϵ Ori (BO Ia, Hd 37128) is described. A list of observed lines, their identification and blend-free equivalent-width is presented. The two unidentified emission lines at λ4486 and λ4054 are found to be present. The profiles of a number of important spectral lines are given. (NL)

30573 SPECTRUM OF THE SUPERGIANT EPSILON ORIONIS (BO Ia). II. Radial Velocities Curve of Growth Analysis. Lamers, H. J. (Rijksuniversiteit, Utrecht). pp 35-42 of Studies on the Structure and Stability of Extended Stellar Atmospheres. Lamers, H. J. (ed.). Utrecht; Rijksuniversiteit (1974).

The visual spectrum of the supergiant ϵ Ori (BO Ia, HD 37128) is discussed. Differential radial velocities are shown to be absent, except for Hα, which seems to show a negative velocity. A simple curve of growth analysis yields an ionization temperature of 25,000°K, except for Si which yields a somewhat lower temperature. The LTE-abundances derived agree very well with those in τ Sco (BO V), which may indicate that ϵ Ori has not yet passed through the red-giant stage. The microturbulent velocity is at least 16 km/s and possibly 28 km/s. The presence of the two unidentified emission lines at 4500 Å is reported, as well as some indications that line emission fills in several absorption lines, which are characteristic for Of stars. (NL)

30574 SPECTRUM OF THE SUPERGIANT EPSILON ORIONIS (BO Ia). III. The Basic Parameters. Lamers, H. J. (Rijksuniversiteit, Utrecht). pp 43-72 of Studies on the Structure and Stability of Extended Stellar Atmospheres. Lamers, H. J. (ed.). Utrecht; Rijksuniversiteit (1974).

The spectroscopic and photometric observations and the angular diameter of the star ϵ Ori (HD 37128, BO Ia) are compared with predictions from a grid of NON-LTE model atmospheres. The absolute flux at 4430 Å, the Balmer jump, the equivalent widths of Hβ and Hγ and the Si IV/Si III ratio are predicted correctly by a plane parallel Non-LTE model atmosphere with $T_{eff} = 30{,}500 \pm 2000$°K and $\log g = 3.0 \pm 0.1$ cm s^{-2}. There is no evidence for Lyman α pumping of the $He^+(2\text{-}4)$ transition. The absolute flux distribution shows that the hump at 2200 Å in the interstellar extinction curve is very small in the direction of ϵ Ori. The corrected flux distribution in the visual region is steeper than predicted. The small flux deficiency in the near ultraviolet indicates that T_{eff} is at least 500°K smaller than found from the visual spectrum. There are no indications for sphericity effects in the atmosphere of the star. The basic parameters are $T_{eff} \lesssim 30{,}000 \pm 2000$°K, $\log g = 3.0 \pm 0.1$ cm s^{-2}, $R = 3^{+8}_{-2}{}^{+3}_{-3} R_\odot$ $M = 35^{+15}_{-8}{}^{+5}_{-5} M_\odot$, $\log (L/L_\odot) \lesssim 5.88^{+13}_{-14}{}^{+13}_{-14}$. These values agree reasonably with published evolutionary tracks. (auth)

30575 FORCE ASSOCIATED WITH ABSORPTION OF SPECTRAL LINE RADIATION. Castor, J. I. (Joint Inst. for Lab. Astrophysics, Boulder, CO). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 279-306(Nov 1974).

The body force on stellar material produced when radiation is absorbed or scattered by atoms, that is, the force derived from the radiative stresses, is studied for the case in which the radiation is produced by line emission of a two-level atom according to the mechanism of noncoherent scattering with complete redistribution. The force is considered for cases with either Doppler or Voigt absorption profiles in static atmospheres with and without the effect of an overlapping continuum, and also in rapidly expanding atmospheres. Approximate analytic results are obtained in several asymptotic regimes. It is suggested that for static atmospheres the force is represented to order-of-magnitude accuracy by the result for LTE with the damping wings and the overlapping continuum omitted. This gives a simple relation, that for optical depths which are greater than unity in the line, but less than unity in the continuum, the force varies as the inverse of the optical depth. The force due to the line alone is very small for optical depths greater than unity in the continuum. In rapidly expanding atmospheres the force is also represented by this formula, except that the optical depth takes the velocity gradient into account. A consequence of these relations is that the force due to an optically thick line is independent of the strength of the line. (auth)

30576 SPECTRAL TYPE-COLOUR ANOMALY FOR LONG PERIOD CEPHEIDS IN THE MAGELLANIC CLOUDS. Feast, M. W. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 273-278(Nov 1974).

The long-period Cepheids in the Magellanic Clouds are too red for their spectral types. A possible interpretation is that this is due to (circumstellar?) absorption. In that case the Cepheids with periods greater than 100 days are about 1 mag brighter than previously supposed and the mean period–luminosity relation does not flatten out at the long period end. (auth)

30577 OBSERVATIONS AND THEORY OF Mg II LINES IN EARLY TYPE STARS. II. Theory and Predicted Profiles. Snijders, M. A. J. (Univ., Brussels); Lamers, H. J. pp 81-114 of Studies on the Structure and Stability of Extended Stellar Atmospheres. Lamers, H. J. (ed.). Utrecht; Rijksuniversiteit (1974).

The profiles of the Mg II lines at 2795.5 and 2802.7 Å ($3^2s - 3^2P$), 2790.7 and 2798.0 Å ($3^2P - 3^2D$), 4481.1 and 4481.3 Å ($3^2D - 4^2F$) are computed in a grid of model atmospheres with $8000 \leq T_{eff} \leq 35000$ K and $2.5 \leq \log g \leq 4.0$ by means of LTE and Non-LTE theories of line formation. The effects of the various physical assumptions on the strength of the Mg II lines are discussed. The lines are sensitive to the amount of UV line blanketing in atmospheres of $T_{eff} \geq 15000$ K. The inclusion of the optically forbidden 3s-3d transition is important for the evaluation of the 3d-level population. The equivalent width, with central depression

and the full half-width of the lines are presented in a form useful for comparison with the observations. (NL)

30578 OBSERVATIONS OF STARS NEAR X-RAY SOURCES. Webster, B. L. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 53P-58P(Nov 1974).

Stars in the fields of several x-ray sources have been examined photoelectrically and spectroscopically. Photometry of the carbon star near 3U 1516-56 (= Cir X-1) is given. Stars suggested for further study are two interesting early-type stars in the 3U 1145-61 error box, one of which is variable with an extended envelope, and a high excitation symbiotic star in the 3U 1746-37 error box. (auth)

30579 INFRARED OBSERVATIONS OF YOUNG STARS. V. The Faint Members of the Orion Population. Cohen, M. (Univ. of California, Berkeley). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 257-272(Nov 1974).

New infrared observations are presented of 120 faint stars of the Orion Population in the 2.2- to 18-μ region. Brightness in the infrared and a flat energy distribution are found to be common characteristics. Nebulous and nonnebulous T Tauri variables in the Taurus dark clouds are found to be distinct in a number of infrared properties: it is suggested that the nebulous objects are more massive and/or somewhat younger than the other stars. The hypothesis that circumstellar dust grains thermalize stellar ultraviolet and visible radiation to produce the infrared by thermal emission is strengthened by the new data. A remarkably uniform picture of early stellar evolution is emerging from the infrared observations of stars in several major complexes of young objects. (auth)

30580 OBSERVATIONS AND THEORY OF Mg II LINES IN EARLY TYPE STARS. III. The Observations and a Comparison With the Predictions. Lamers, H. J. (Rijksuniversiteit, Utrecht); Snijders, M. A. J. pp 115-152 of Studies on the Structure and Stability of Extended Stellar Atmospheres. Lamers, H. J. (ed.). Utrecht; Rijksuniversiteit (1974).

The equivalent width of the ultraviolet Mg II lines from the 3s-3p and 3p-3d transitions in the spectra of 106 stars and of the visual lines from the 3d-4f transition in 48 stars of type 04 to A3 are presented. The ultraviolet observations were made by the Orbiting Stellar Spectrophotometer S59, the Copernicus Satellite and various balloon experiments. The visual observations were collected from the literature. The observed equivalent widths in normal stars of classes Ia to V agree roughly with the predictions over the entire range from 08-A2 if an abundance of $Mg/H = 3 \times 10^{-5}$ is adopted. In these stars no evidence was found for differences in the magnesium abundances, which indicates that the cosmic abundance is close to the solar value of $Mg/H = 2.9 \times 10^{-5}$. The strength of the Mg II lines in the spectra of the five peculiar stars, three Be-stars and three shell-stars is briefly discussed. (NL)

30581 MASS LOSS FROM THE A-TYPE SUPERGIANT α Cyg. Lamers, H. J. (Rijksuniversiteit, Utrecht). pp 153-168 of Studies on the Structure and Stability of Extended Stellar Atmospheres. Lamers, H. J. (ed.). Utrecht; Rijksuniversiteit (1974).

From conference on astronomy in the ultraviolet; London, England (9 Apr 1974).

The Mg II resonance lines in α Cygni (A2Ia) are studied from 22 spectral scans obtained by the experiment S59. The cores of the resonance lines are shifted by -130 km/s and the short wavelength side of the core is shifted about -350 km/s. The lines are compared with predicted profiles in an expanding atmosphere. This comparison suggests a rate of mass loss of $-dM/dt \leq 3\ 10^{-10}\ M_\odot$/yr. The atmosphere seems to be accelerated up to velocity of 300 km/s. The acceleration might be produced by the near-UV resonance lines of singly ionized metals. The observations of the near-UV spectrum of A-type supergiants with a high spectral resolution is recommended. (NL)

30582 CHARACTERISTICS OF NON-THERMALLY HEATED STELLAR ATMOSPHERES. Lamers, H. J.; Kuperus, M. (Rijksuniversiteit, Utrecht). pp 169-200 of Studies on the Structure and Stability of Extended Stellar Atmospheres. Lamers, H. J. (ed.). Utrecht; Rijksuniversiteit (1974).

A study is made of the structure of non-thermally heated stellar atmospheres as a function of the mechanical energy flux and the dissipation length. The conditions for a stationary atmosphere with and without mass loss are discussed. The characteristic types of atmospheres are considered: atmospheres in hydrostatic equilibrium, loosely bound atmospheres with a strong radiation pressure. For the first two types of models we derive order-of-magnitude estimates for the maximum temperature and the rate of mass loss. The influence of chromospheric heating on the conditions at the critical point in an atmosphere with a strong radiation pressure is discussed. The results are compared with the observed temperatures and rates of mass loss in the sun, an M-type supergiant and BO-type supergiant. (NL)

30583 NON-THERMALLY HEATED ATMOSPHERES OF EARLY TYPE STARS. Lamers, H. J. (Rijksuniversiteit, Utrecht); de Loore, C. pp 201-232 of Studies on the Structure and Stability of Extended Stellar Atmospheres. Lamers, H. J. (ed.). Utrecht; Rijksuniversiteit (1974).

The evidence for predicted and observed mechanical fluxes in early type stars is collected. The coincidence of a large mechanical flux and a large rate of mass loss in early type supergiants and in late type supergiants suggests that the mass loss phenomenon is related to the dissipation of mechanical flux and consequently to the presence of a chromosphere. The resemblance in the temperature dependence of the microturbulent flux and the predicted flux-of-radiation driven sound waves suggests that these phenomena are associated. The observed short-time variations in the line profiles of some early-type stars indicate the presence of sound waves with a wavelength equal to the photospheric pressure scale height. A partial grid of model chromospheres was computed, assuming that the dissipation of mechanical flux can be described by the weak-shock theory, and that the effective gravity is positive throughout the chromosphere. The maximum temperature and the mass flux can be expressed in simple formulae of the mechanical flux and the period of the shocks. The computed chromospheric temperature of early type stars is much larger than observed. This indicates that the flow passes the critical point in the chromosphere, which requires a negative effective acceleration. (NL)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 30468, 30473, 30474, 30526, 30544, 30550, 30576, 30578, and 30703.

30584 (UCID-15885) SXRE, A LARGE-AREA, THOR-CARRIED X-RAY ASTRONOMY EXPERIMENT. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1971. 55p. Dep. NTIS $5.75.

This report describes an experiment launched September 24, 1970. The scientific data obtained is being reported separately as analysis is completed (UCRL-73194 and UCRL-73232). In the event that details of the flight and equipment are needed to fully understand the scientific results, this report may be referred to. It is meant as a reference document, not to be read cover to cover. Some data, such as detector cosmic-ray-induced backgrounds, have been included because other, heavy, space x-ray observatories are planned. The comparison between detection backgrounds measured on high and low mass payloads is pertinent to these plans. The major problems and disappointments have all been described so they are available in the record. This document is the launch report. (WDM)

30585 TIME DEPENDENCE OF THE INTEGRATED STOKES PARAMETERS OF COMPACT RADIO SOURCES AT 5 GHz. Seielstad, G.A.; Berge, G.L. (Owens Valley Radio Observatory, California Institute of Technology, Pasadena, California 91125). Astron. J. 80: No. 4, 271-281 (Apr 1975).

We have monitored the integrated 5-GHz radio emission, including the complete polarization state as well as the flux density, of 15 compact radio sources for a period of 27 months. In the data presented herein there are several examples of interesting time variations. However, the diverse behavior and other properties of the sources defy any satisfactory generalizations regarding mechanisms. Instead we are led to a discussion of the individual sources separately. (auth)

30586 SIMULTANEOUS INTERFEROMETRIC AND SPECTROMETRIC OBSERVATIONS OF PULSAR 0329+54. Galt, J.A. (Dominion Radio Astrophysical Observatory, Penticton, British Columbia, Canada); Broten, N.W.; Legg, T.H. Astron. J. 80: No. 4, 311-317 (Apr 1975).

Observations of the pulsar with an interferometer of lobe spacing 5.5×10^{-2} arcsec were made in the frequency band 408-412 MHz. The rms image motion of the pulsar was found to be $\leq 2.5 \times 10^{-3}$ arcsec, a result consistent with thin-screen-scattering theory and with the assumed distance to the pulsar. Dynamic spectra with a frequency resolution of 10 kHz show fine structure in the distribution of pulse energy. Measurements made on features in the dynamic spectra are combined with the image motion limit to derive crude estimates of the pulsar's distance. (auth)

30587 PENCIL BEAM OBSERVATIONS OF ABELL CLUSTERS OF GALAXIES. I. 2695 MHz. Owen, F.N. (National Radio

Astronomy Observatory, Green Bank, West Virginia). Astron. J. 80: No. 4, 263-270 (Apr 1975).

Observations at 2695 MHz of radio sources in the direction of Abell clusters of galaxies are reported. Positions, flux densities, and angular sizes are given for 226 sources. (auth)

30588 OH ABSORPTION IN THE RADIO SOURCE W51. II. DISTRIBUTION OF ABSORBING GAS. Slysh, V.I. (Institute for Space Research, Academy of Sciences of the USSR, Moscow). Sov. Astron.—AJ 18: No. 4, 405-409 (Jan 1975).

Measurements of 18-cm OH absorption in the thermal-source complex W51 with a $3.4\times18'$ antenna beam are discussed. An analysis of the space distribution of the absorbing material shows that it is concentrated in two types of clouds. Clouds of the first type are not physically associated with the thermal sources; they have large linear dimensions and the low density typical of the interstellar medium. Clouds of the second type have a size and density similar to Heiles' dust clouds. These compact clouds contain thermal radio sources whose microwave radiation raises the excitation temperature of the 18-cm OH transition. Three such clouds are found in the W51 complex; their radial velocities of 51, 56, and 69 km/sec are close to the velocities of the corresponding thermal sources and sources of CO millimeter emission. (auth)

30589 A MODEL FOR SIMULTANEOUS SYNCHROTRON AND INVERSE COMPTON FLUXES. Peterson, F.W.; King, C. III (National Radio Astronomy Observatory, Charlottesville, Virginia). Astrophys. J. 195: No. 3, 753-759 (1 Feb 1975).

Optical and radio fluxes, possibly correlated, from two extragalactic variable radio sources are analyzed on the assumption that the radio flux is synchrotron radiation whereas the optical flux is inverse Compton radiation resulting from scattering of the synchrotron photons. Detailed analysis of an outburst in 3C 120 shows that a description of the evolution of the outburst, based on this interpretation, is compatible with its description on the basis of the adiabatic expansion model in all respects but the rate of falloff of the optical flux. Compton optical and X—ray fluxes are calculated for the 1972 radio flare in Cygnus X—3. (auth)

30590 CYGNUS X—1: AN INTERPRETATION OF THE SPECTRUM AND ITS VARIABILITY. Thorne, K.S. (California Institute of Technology); Price, R.H. Astrophys. J. Lett. 195: No. 3, L101-L105 (1 Feb 1975).

X—ray observations of Cygnus X—1 are compared with the "standard" model (accretion disk surrounding a rotating black hole). Attention focuses on the shape of the X—ray spectrum, the fluctuations in X—ray intensity, and the 1971 transition in the spectrum. There are several encouraging agreements of model and data, but a detailed comparison awaits further theoretical and observational studies. Several predictions of the standard model are listed as suggestive guides for furture work. (auth)

30591 ON THE NATURE OF THE BINARY SYSTEM CONTAINING THE PULSAR PSR 1913+16. Masters, A.R.; Roberts, D.H. (Department of Physics, University of Illinois). Astrophys. J. Lett. 195: No. 3, L107-L111 (1 Feb 1975).

We consider the geometry and apsidal motion of the binary system containing the pulsar PSR 1913+16 and show that the observations already made by Hulse and Taylor strongly suggest that the companion to the pulsar is a compact star or, possibly, a helium main—sequence star. General—relativistic properties are discussed. We note that further observations of this system may provide the first direct measurement of the mass of a pulsar. (auth)

30592 SOME IMPLICATIONS OF PERIOD CHANGES IN THE FIRST BINARY RADIO PULSAR. Brecher, K. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. Lett. 195: No. 3, L113-L115 (1 Feb 1975).

The absence of a large advance of the periastron of the first binary pulsar is shown to imply that the unseen companion is also collapsed. The existence of a lower limit to the mass of the observed pulsar of about 0.3 $M_\odot$ requires a minimum general relativistic periastron advance of about 2° yr^{-1}. Other causes of apparent and true pulse period changes are also briefly considered. (auth)

30593 Hα OBSERVATIONS AND THE DISTRIBUTION OF CIRCUMSTELLAR MATERIAL IN THE HD 77581 SYSTEM (3U 0900—40). Bessell, M.S.; Vidal, N.V.; Wickramasinghe, D.T. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. Lett. 195: No. 3, L117-L120 (1 Feb 1975).

Coudé spectra taken at Hα over many cycles show a nearly constant emission with some periodic changes in the blue—shifted absorption components. It is suggested that the absorption components arise from an asymmetric outflow of gas (with respect to the line centers) from the vicinity of the inner Lagrangian point L_1 and perhaps the accretion disk of the secondary. The persistent outflow from L_1 seen in Hα during the phases immediately following primary minimum may be responsible for distortion of the light and radial—velocity and explain the same phase of apparent "periastron" found in HD 77581, HD 153919, and Cyg X—1. (auth)

30594 THE INTERACTION BETWEEN THE BLAST WAVE OF A SUPERNOVA REMNANT AND INTERSTELLAR CLOUDS. McKee, C.F. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory); Cowie, L.L. Astrophys. J. 195: No. 3, 715-725 (1 Feb 1975).

When an interstellar (or circumstellar) cloud is overtaken by a blast wave, a shock is driven into the cloud. We derive the velocity of the shock as a function of the cloud density and discuss the effects of thermal conduction between the blast wave and the shocked cloud. It is shown that many of the observed features of the quasi—stationary flocculi in Cas A can be accounted for by this model. Some aspects of the evolution of supernova remnants (SNRs) in a cloudy interstellar medium are discussed. We argue that the optically observed filaments in older SNRs represent shocked interstellar clouds with a significantly low velocity than the blast wave propagating in the intercloud medium. The dynamics of large SNRs are relatively unaffected by interstellar clouds. It is suggested that most optically observed SNRs are still in the adiabatic phase of their expansion. Application of our results to the Cygnus Loop show that Woltjer's interpretation of the optical and X—ray observations is self—consistent. Vela X and Shajn 147 are also briefly discussed. (auth)

30595 PHYSICAL PARAMETERS OF THE CENTAURUS X—3 SYSTEM. Osmer, P.S. (Cerro Tololo Inter—American Observatory); Hiltner, W.A.; Whelan, J.A.J. Astrophys. J. 195: No. 3, 705-707 (1 Feb 1975).

Photographic spectra of Cen X—3 show that the primary star has a spectral type near O6.5 with weak, variable emission at λλ4640 and 4686. No orbital motion of the emission or absorption lines is detected; for the latter the upper limit is $\sim \pm 50$ km s^{-1}. Analysis of the available data indicates that the primary is a factor of 2—3 less massive than expected from normal evolutionary models while the X—ray source has a mass near 1.5 $M_\odot$. (auth)

30596 LONG TERM VARIABILITY OF CYG X-1 IN HARD X-RAYS. Frontera, F.; Fuligni, F.; Cavani, C. (Consiglio Nazionale delle Ricerche, Bologna (Italy)). Astrophys. Space Sci.; 32: No. 1, 197-203(Jan 1975).

Results of the analysis of four balloon observations of Cyg X-1 in the energy range 20 to 200 keV are reported. Long term time variability of the flux is confirmed and is estimated to amount to a factor 1.5 to 2. The source appears to remain in a state of lower flux for longer times. No obvious correlation with the low-energy behavior following the transition detected by Uhuru is found. (auth)

30597 THE MASSES OF BINARY X-RAY SOURCES. de Freitas Pacheco, J. A. (Sao Paulo Univ. (Brazil). Instituto Astronomico e Geofisico). Astrophys. Space Sci.; 32: No. 1, 205-210(Jan 1975).

From optical and x-ray data available for the binary x-ray sources, the masses of the components were determined univocally in three systems. A discussion about the masses in other three systems is also presented. Besides Cyg X-1, SMC X-1 is another black-hole candidate. (auth)

30598 PULSARS AND THE ORIGIN OF COSMIC RAYS. Rengarajan, T. N. (Tata Inst. of Fundamental Research, Bombay (India)). Astrophys. Space Sci.; 32: No. 1, 55-75(Jan 1975).

The capabilities and limitations of pulsars as sources of cosmic rays are reviewed in the light of experimental observations. Pulsars can supply the cosmic-ray power if they have rotational velocities in excess of 700 rad s^{-1} at birth. Though this is theoretically possible, there is no experimental proof for the same. Pulsars can accelerate particles to the highest energies of 10^{20} eV, but in general, the spectra on simple considerations, turn out to be flatter than the observed cosmic-ray spectrum. At the highest energies, absorption processes due to fragmentation and photodisintegration dominate for heavy nuclei. The existence of a steady flux of cosmic rays of energy greater than 10^{17} eV demands acceleration of particles to last over fifty years, the time interval between supernovae outbursts, whereas the expected period of activity is less than a few years. Finally, the problem of anisotropy with relevance to pulsars as sources and the possibility of observing pulsar accelerated particles from galactic clusters is considered. (auth)

30599 HOT VIBRATING WHITE DWARF MODELS OF PULSATING X-RAY SOURCES. Cameron, A. G. W. (Harvard Coll. Observatory, Cambridge, Mass. (USA)). Astrophys. Space Sci.; 32: No. 1, 215-229(Jan 1975).

A number of white dwarf models have been calculated which correspond to various radial and nonradial modes of vibration with eigenfrequencies in agreement with the observed pulsation

frequencies of the x-ray sources Hercules X-1 and Centaurus X-3. Most of the white dwarf models have hot interiors, but for calculational purposes these were simplified so that the bulk of the interior was isothermal, and the surface layers were designed to produce an energy generation rate of 10^{37} erg s^{-1} and to transport this energy continuously to the surface by radiative transfer. Cold white dwarfs have a fairly large spread of masses corresponding to the different overtone modes with the given eigenfrequencies, but in the hot models this spread of masses is greatly reduced, for both radial and nonradial modes. It is concluded that if the pulsating x-ray sources are hot white dwarfs, the mass of Cen X-3 probably lies in the range 0.7 to 1.2 $M_\odot$, and the mass of Her X-1 probably lies in the range 1.1 to 1.25 $M_\odot$ (in accord with observation. (auth)

30600 THE MOTION OF CHARGED PARTICLES IN A STRONG ELECTROMAGNETIC FIELD AND CURVATURE RADIATION. Chugunov, Yu. V.; Eidman, V. Ja.; Suvorov, E. V. (Radiophysical Research Institute, Gorky, USSR). Astrophys. Space Sci.; 32: No. 1, L7-L10(Jan 1975).

The features of the relativistic charged particle motion and emission due to the radiative damping in the strong electromagnetic fields are investigated. It is shown that the radiative force responsible for curvature radiation is associated with the particle drift in an inhomogeneous magnetic field. The adiabatic trajectory is obtained for the relativistic particle, moving in a strong static electromagnetic field, particle energy being determined by the balance of the work of the electric field and the energy losses through curvature radiation. (auth)

30601 PULSAR HYDROGEN LINE ABSORPTION AND THE ELECTRON DENSITY IN THE INTERSTELLAR MEDIUM. Gomez-Gonzales, J.; Guelin, M. (Observatoire, Meudon, France). Astron. Astronphys.; 32: No. 4, 441-446(Jun 1974).

Nine new pulsars were observed for 21-cm line absorption. Distance limits were derived for six of them. The new distances, together with previous pulsar data, were used for an analysis of the electron distribution in the interstellar medium. The electron density, averaged over a few kiloparsec path close to the galactic plane, was found to be uniform and was 0.03 cm^{-3}. (auth)

30602 OBSERVATIONS OF INTENSITY AND LINEAR POLARIZATION IN SUPERNOVA REMNANTS AT 11 cm WAVELENGTH. Velusamy, T.; Kundu, M. R. (Univ. of Maryland, College Park). Astron. Astrophys.; 32: No. 4, 375-390(Jun 1974).

Distributions of intensity and linear polarization at 11 cm in twenty-four galactic sources in the northern sky are presented. The observations were made with angular resolution of ~5′ using the 300-ft. telescope of the National Radio Astronomy Observatory. Twenty sources were mapped in both total and polarized intensities and four were mapped in total intensity only. The present maps at 11 cm have the highest resolution yet attained on many of these sources. The results indicate that the galactic sources G 53.9 + 0.3, G 54.4 – 0.3, G 69.0 + 2.7, and G 93.4 + 1.8 are possible supernova remnants which until now are not listed as such in any of the catalogues. Observations of linear polarization at 6 cm in two sources, 3 C 434.1 and G 93.4 + 1.8, are also presented. The characteristics of the observed sources are discussed. (auth)

30603 DETERMINATION OF UPPER MASS LIMITS FOR MASSIVE X-RAY BINARIES. Hensberg, G.; van den Heuvel, E. P. J. (Univ. of Amsterdam). Astron. Astrophys.; 33: No. 2, 311-313(Jul 1974).

Upper mass limits for the visible companions of binary x-ray sources are determined from the observed system parameters. This shows the OB-supergiant components of Cyg X-1 and SMC X-1 to be less massive than about 25 $M_\odot$ and 21 $M_\odot$, respectively. (auth)

30604 OBSERVATIONS OF THE GALACTIC CENTER COMPLEX OF RADIO SOURCES AT A FREQUENCY OF 1418 MHz. Rougoor, G. W. (Leiden Observatory); Hoegbom, J. A.; Sandqvist, A. Astron. Astrophys.; 33: No. 3, 459-461(Jul 1974).

A map of the galactic center region with a resolution of 1.5 × 2.5 arcmin reveals that the H II regions G + 0.7 – 0.0, G + 0.5 – 0.0, and G – 0.6 – 0.1 are still optically thin at 1418 MHz. (auth)

30605 COLD H I SHELL AROUND THE SUPERNOVA REMNANT W 44. Knapp, G. R.; Kerr, F. J. (Univ. of Maryland, College Park). Astron. Astrophys.; 33: No. 3, 463-467(Jul 1974).

A shell of cold H I gas was found around the supernova remnant W 44. The shell has a diameter of ~80 pc, a mass of ~5×10^3 $M_\odot$, and probably contains ~6×10^{47} erg of kinetic energy. (auth)

30606 FORMALDEHYDE AND OH OBSERVATIONS IN THE DIRECTION OF H I 21-cm SELF-ABSORPTION FEATURES. Hoeglund, B.; Andersson, C. (Onsala Space Observatory, Sweden). Astron. Astrophys.; 33: No. 3, 389-397(Jul 1974).

6-cm formaldehyde and 18-cm OH radiation was searched for in the direction of 41 H I self-absorption features selected from the Maryland–Green Bank 21-cm line survey. The results are positive at four positions; possible reasons for the small number of detections are discussed. Two of the features detected show both a low-velocity and a high-velocity OH component, the low-velocity component being extended in one case. At one position in the W 3 region the OH excitation temperature is probably <3 K. In connection with these observations a 2.5° × 2.5° area centered on W 3 was surveyed for OH at 1612 and 1667 MHz, and one new OH/H_2CO dust cloud source was detected. It has the same radial velocity as the H II region. No H I self-absorption feature is associated with this cloud. (auth)

30607 OBSERVATIONS OF THE EXCITED LINES OF OH AT A WAVELENGTH OF 6.3 cm. Baudry, A. (Univ., Bordeaux). Astron. Astrophys.; 33: No. 3, 381-384(Jul 1974).

Six type I OH sources that are detected in H_2O and in excited-state OH at 5 cm wavelength were observed in the $^2\Pi_{\frac{1}{2}}$ J = ½ state of OH. The F = 1 → 0 transition was detected in W 3 continuum and in On 1; in addition the nonthermal broad emission observed in Sag B 2 by Gardner and Ribes (1971) was confirmed. A brief discussion of the data in the light of ultraviolet, infrared, and collisional pumping models, is presented. (auth)

30608 EXTENSION OF THE ABSOLUTE FLUX DENSITY SCALE TO 22.285 GHz. Janssen, M. A. (Jet Propulsion Lab., Pasadena, CA); Golden, L. M.; Welch, W. J. Astron. Astrophys.; 33: No. 3, 373-377(Jul 1974).

To extend the absolute flux density scale at microwave wavelengths, observations of standard sources at 22.285 GHz were made. These observations employ the absolute calibrations of the 6.1-meter antenna of the Hat Creek Observatory of the University of California and are accurate to 4%. Interpolation formulas for each nonthermal standard source were derived by combining these data with those determined at lower frequencies. The suitability of employing the standard sources for calibrating other antennas is discussed. (auth)

30609 OBSERVED ANISOTROPY IN THE DISTRIBUTION OF RADIO SOURCES IN THE GB REGION OF THE SKY. II. Source Counts in the Different Parts of the GB Region. Machalski, J.; Zieba, S.; Maslowski, J. (Jagiellonian Univ., Krakow). Astron. Astrophys.; 33: No. 3, 357-361(Jul 1974).

Differential counts of radio sources in each of four selected, equal sub-regions of the GB region are discussed. It is found that the probability of existence of the same population law governing the distribution of radio sources (source counts) in all the four sub-regions is very low. It is concluded that the anisotropy in the source counts seems to be a real effect in the GB region of the sky. This conclusion is supported by a number of numerical experiments with artificial sources, generated by a computer (according to some population laws) and distributed at random over the whole GB region. (auth)

30610 STRONG WAVE PROPAGATION IN A MAGNETIZED PLASMA. Stewart, P. (Univ. of Manchester, Eng.). Astron. Astrophys.; 34: No. 3, 463-464(Sep 1974).

A dispersion relation is calculated for a strong circularly polarized wave which propagates parallel to a uniform magnetic field for a hot relativistic electron gas. The relation is discussed in connection with wave propagation through the Crab Nebula. (auth)

30611 OBSERVATIONS OF THE STRUCTURE AND POLARIZATION OF INTENSE EXTRAGALACTIC RADIO SOURCES AT 1415 MHz. Hoegbom, J. A.; Carlsson, I. (Stockholm Observatory). Astron. Astrophys.; 34: No. 3, 341-354(Sep 1974).

The Westerbork synthesis radio telescope was used to survey the polarization structure of 79 intense radio sources at 1415 MHz. Each source was observed at a number of discrete hour angles and two-dimensional maps were contructed from the interferometer measurements using the CLEAN reduction procedure. The results are presented in the form of contour maps and a table of the positions, flux densities, and polarization of distinct components in the source brightness distributions. Regions of linear polarization were detected in most of the observed sources. In general, the polarized brightness distribution shows a more complex angular distribution with less symmetry than does the total brightness distribution. The degree of polarization usually stays below 10% in the brighter source components. The weaker extended regions in individual sources tend to be more strongly polarized and values well above 20% were noted in such areas. (auth)

30612 STRUCTURE OF THE COMPLEX H II REGION IC 1318. Goudis, C.; Meaburn, J. (Univ. of Manchester, Eng.). Astron. Astrophys.; 34: No. 3, 437-443(Sep 1974).

The ratio of the brightnesses of the Hα and [N II] lines was

measured over the IC 1318 H II complex. Several distinct maxima in the brightness of the thermal radio emission from the same region. (auth)

30613 RADIATIVE ACCELERATION IN THE NEIGHBORHOOD OF QUASISTELLAR OBJECTS. Kippenhahn, R.; Perry, J. J.; Roeser, H. J. (Goettingen Univ. Observatory, Ger.). Astron. Astrophys.; 34: No. 2, 211-224(Aug 1974).

The final velocities obtainable by a gas were investigated in ionization and thermal equilibrium in the non-thermal radiation field of a QSO, which is accelerated by momentum absorption from this radiation field, as a function of plausible parameters of the QSO, such as its total luminosity and characteristic spectrum, and of the gas, such as its initial density and its expansion rate. With a simplified model the calculations for terminal velocities agree with observed absorption systems if QSO's are assumed to be at cosmological distances. (auth)

30614 4850-MHz OBSERVATIONS OF A SAMPLE OF RADIO SOURCES IDENTIFIED WITH QUASARS. Crovisier, J.; Le Squeren, A. M. (Observatory, Meudon, France). Astron. Astrophys.; 34: No. 2, 285-289(Aug 1974).

A homogeneous sample of 55 faint radio sources from the B 2.1 catalogue identified with blue stellar objects has been observed at 4850 MHz. Statistical properties such as spectral index distribution and R–α diagram are investigated. A comparison with the "lacertid" class of radio sources is made. (auth)

30615 MEASUREMENTS OF THE CRAB NEBULA AND THE PULSAR NP 0532 IN THE HARD X-RAY REGION. Zimmermann, H. U. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Astron. Astrophys.; 34: No. 2, 305-307(Aug 1974).

On July 2, 1971, an X-ray experiment was performed in Palestine, Texas (USA). The experiment consisted of 2 NaI (Tl)-detectors with a field of view of about 10° FWHM. The index of the differential energy spectrum for the nebula was found to be -0.95 ± 0.20. Furthermore, light-curves of the pulsar NP 0532 were derived with a time resolution of 0.5 ms and 1 ms. From these curves the ratio of the pulsed to the whole radiation was found to be $20 \pm 3\%$. Within the measured energy range, no dependence of this ratio on the quantum energy could be found. The index of the pulsed spectrum was derived as -1.02 ± 0.20. The results are discussed. (auth)

30616 RECOMBINATION LINE EMISSION FROM AN H II REGION SURROUNDING THE NUCLEUS OF THE GALAXY. Pauls, T.; Mezger, P. G.; Churchwell, E. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 34: No. 2, 327-331(Aug 1974).

Broad emission lines were observed in the galactic center source Sgr A at a frequency of 5 GHz. The lines are tentatively identified as H 109α, He 109α and H 137β and are believed to be coming from the thermal source Sgr A West. This source probably lies in the center of the dense nuclear star cluster and is associated with the nucleus of the Galaxy. Within the large observational errors, the line parameters are compatible with emission under conditions of thermal equilibrium, a normal He/H abundance and $v_{LSR} = 0$. (auth)

30617 H II REGION W 3 IN THE NEAR INFRARED. Beetz, M.; Elsaesser, H.; Weinberger, R. (Max-Planck-Institut fuer Astronomie, Heidelberg). Astron. Astrophys.; 34: No. 2, 335-337(Aug 1974).

New information on three infrared sources in W 3 is derived from photographs at 0.92 μm (I) and 0.70 μm (R) which were made with an image tube camera. Evidence for the stellar nature of IRS 2 is presented. A second star (IRS 2a) close to the center of W 3(A) seems to be also of early spectral type and a source of ionization. The high amount of interstellar extinction in front of W 3 obtained by Wynn–Williams et al. is confirmed. (auth)

30618 LIGHT FLASH PRODUCED BY AN X-RAY SOURCE IN OUTER SPACE. Zhemerev, A. V.; Medvedev, Yu. A.; Stepanov, B. M. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 531-534 (1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 581-584(1974).

The characteristics of the light flash excited in outer space by a pulsed x-ray source with Planck spectrum and temperature $kT \sim 1$ keV are examined. The possibility of determining altitude of a source from the time characteristics of the light flash is shown in principle. (auth)

30619 RADIO SOURCE 0844 + 31 B. Grueff, G.; Vigotti, M. (Univ., Bologna). Astron. Astrophys.; 35: No. 3, 491-492(Oct 1974).

The radio source 0844 + 31B = 4C 31.32 is very close to a 13 mag giant elliptical galaxy, and to an 18 mag quasar with a redshift 1.8. It is shown that the correct identification is the galaxy, and that the quasar appears to be unrelated to both the galaxy and the radio source. (auth)

30620 SECOND DEEP SURVEY WITH THE WESTERBORK TELESCOPE AT 1415 AND 610 MHz: AN ATTEMPT TO OBTAIN DEEP IDENTIFICATIONS. Katgert, J. K. (Observatory, Leiden); Spinrad, H. Astron. Astrophys.; 35: No. 3, 393-406(Oct 1974).

A radio survey was made of an area centered at $01^h03^m + 29°$, using the Westerbork telescope at 1415 MHz. The completeness limit of the survey is 7 mf.u. Additional observations were made at 610 MHz. The Lick 120″ telescope was used to obtain deep (O 98 –O 2 emulsion) plates to serve as an optical counterpart. A catalogue is presented of 58 sources found in the survey. 53 of these comprise a complete sample. 31 sources of the complete sample lie in areas of which Lick plates were taken. Of the sources in Lick plate areas, 11 could be identified with galaxies and 3 with possible QSO's, yielding an identification percentage of 46. For the other 22 sources an identification programme was carried out using Palomar Sky Survey prints and other large 48″ Schmidt plates: three of these sources could be identified with galaxies and two with possible QSO's. The survey was also used to derive source counts and a spectral index distribution. The source counts agree well with those derived for an earlier survey. The spectral index distribution has a mean of 0.52 and a width of 0.39. The explanation for the flatter spectra is not clear but might possibly lie in another source population that begins to dominate the results at low flux densities. (auth)

30621 SEARCH FOR SUPERNOVA REMNANTS IN THE VICINITY OF PULSARS. Weiler, K. W.; Goss, W. M.; Schwarz, U. J. (Univ. of Groningen, Netherlands). Astron. Astrophys.; 35: No. 3, 473-477(Oct 1974).

An area of approximately one square degree was studied around the six pulsars PSR 0329 + 54, PSR 0525 + 21, PSR 0809 + 74, PSR 0823 + 26, PSR 0904 + 77, and PSR 0950 + 08 with the Westerbork Synthesis Radio Telescope (WSRT) at λ21 cm to search for extended regions of radio emission. To the limit of sensitivity of the WSRT, in no case was a significant candidate for a supernova remnant or a pulsar "ghost" found. In four of the six cases the pulsar was detected. Additionally, the unrelated radio sources in the field are described. The sensitivity of the WSRT to extended sources is discussed. (auth)

30622 ORIGEM LOOP: AN OLD SUPERNOVA REMNANT IN THE ANTICENTER. Berkhuijsen, E. M. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 35: No. 3, 429-440(Oct 1974).

The Origem Loop is a well defined ring-like feature in the radio continuum emission at 178 MHz; it is centered at $l = 194.7°$, $b = +0.4°$ and has a diameter between the outer half-power points of 6°. The average spectrum of the loop is straight between 178 MHz and 820 MHz with a spectral index of 0.3 ± 0.2 and the average surface brightness is very low. The distance to the loop is about 1 kpc. The observations are consistent with the Origem Loop being a SNR with a 60 pc radius, expanding at 20 km/s, having an age of about 10^6 years, a density in the interstellar medium of 0.5 cm^{-3}, and an initial explosion energy of about 5×10^{50} erg. This loop might be the largest and oldest SNR known. A number of high-emission regions are seen in the shell, and several Sharpless H II regions containing early-type stars may be part of the shell. This suggests that either star formation has taken place inside the shell, or has been triggered or speeded up by the passage of the shock through the clumpy interstellar medium. For dynamical reasons, this would have happened during the last 7×10^5 years when the shock velocity was less than 40 km/s and the radius more than 40 pc; this period of time is compatible with the time needed for the evolution of early-type stars onto the main sequence. (auth)

30623 MEASUREMENTS OF THE FLUX DENSITY OF WEAK RADIO SOURCES AT FREQUENCIES OF 2.7 AND 10.7 GHz. Pauliny-Toth, I. I. K.; Witzel, A.; Preuss, E. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 35: No. 3, 421-428(Oct 1974).

Flux densities and positions were measured at a frequency of 2.7 GHz for 154 sources taken from the 5 GHz survey of Davis (1971). The sample consisted of all sources in the Davis survey having $|b| \geq 10°$ and a flux density at 5 GHz greater than 0.067 fu (1 fu = 10^3 mfu = 10^{-26} W m^{-2} Hz^{-1}). The accuracy of the measured flux densities was typically 0.01 fu and of the positions better than 15″. For 25 of these sources, flux densities were also measured at 10.7 GHz with an accuracy of 0.02 fu. The distribution of the spectral indices α between 2.7 and 5 GHz appeared to show two maxima, one near $\alpha \sim -0.7$ and one near $\alpha \sim 0$. The comparison of the spectral indices of the sample with those of a sample of strong sources over two ranges of frequency indicated that the curvature of the spectra depends on the limiting flux density for the sample. (auth)

30624 ORBIT, SPECTRUM, AND H_α VARIATIONS OF HD 77581 (3 U 0900-40). Zuiderwijk, E. J. (Univ., Utrecht); van den Heuvel, E. P. J.; Hensberge, G. Astron. Astrophys.; 35: No. 3, 353-360(Oct 1974).

Radial velocities of HD 77581 (3 U 0900-40) obtained from ESO coudé spectra are presented. The revised orbital elements are $P = 8.959d \pm 0.004d$, $e = 0.22 \pm 0.02$ and $f(M) = 0.0147 \pm 0.0011\ M_\odot$. The profile of H_α behaves similar to that in Cygnus X-1, i.e., consists of a wide emission component with an approximately constant radial velocity and a narrower absorption component with a periodically variable velocity. Variations in the profiles of H_β and the He I lines correlate with the H_α variations. From interstellar features a distance of 2.2 ± 0.4 kpc is derived, which yields $M_v = -7.1m \pm 0.4m$. Arguments are presented indicating that supergiants in massive x-ray binaries are unlikely to have suffered appreciable mass loss. The masses of the components of HD 77581 are estimated to be $\geq 30 \pm 5\ M_\odot$ and $\geq 2.5 \pm 0.3\ M_\odot$, respectively. (auth)

30625 PROBLEMS OF OPTICAL IDENTIFICATION OF GALACTIC X-RAY SOURCES OBSERVABLE DURING LUNAR OCCULTATION BY THE EXOSAT/HELOS/ SATELLITE. Reina, C. (Univ., Milan). Soc. Astron. Ital., Mem.; 44: 603-607(1973). (In Italian).

30626 PHOTOELECTRIC OBSERVATIONS OF HD 77581 (2U0900-40). de Freitas Pacheco, J. A. (Univ., Sao Paulo, Brazil); Quast, G. R. Astron. Astrophys.; 35: No. 2, 301-302 (Oct 1974).

UBV photoelectric observations of HD 77581 = 2 U 0900-40 are presented. Comparing the observations with previous data, a possible variation in the secondary minimum is suggested. It is not necessary to invoke the presence of a black-hole in the system in order to explain the spectroscopic and photometric data. (auth)

30627 COSMIC RAYS GUIDED BY A MAGNETIC FIELD: THE SOURCE OF QUASAR EMISSION LINES. Stoner, R. E.; Ptak, R. L. (Bowling Green State Univ., OH). Astron. Astrophys.; 35: No. 2, 191-195(Oct 1974).

The broad emission lines observed in quasars and in the nuclei of Seyfert galaxies can be produced by way of atomic collision processes, with the characteristic velocities for the atomic events corresponding to the observed Doppler broadening. A model is proposed in which suprathermal particles, guided by a magnetic field and diffusing in pitch angel, interact with a stationary gas to produce the broad emission lines. Profiles predicted by the model are in good agreement with observed emission lines in high redshift quasars and Seyfert galaxy nuclei. (auth)

30628 COMPARATIVE STUDY OF LYMAN CONTINUUM, SOFT X-RAY OR HARD X-RAY HEATING OF AN OPTICALLY THIN GAS. Bergeron, J. (Cornell Univ., Ithaca, NY); Collin-Souffrin, S. Astron. Astrophys.; 36: No. 1, 27-40(Nov 1974).

The results of a systematic study of the steady-state equilibrium of a gas heated predominantly by Lyman continuum, soft x-ray or hard x-ray photons are presented. Special emphasis is given to the spectral dependence (i.e., power law, exponential and black-body spectra) and to the effects of low energy cut-offs in the optical to keV energy range. The influence of secondary electrons and Auger transitions for the heavy elements has been taken into account. The present study applies to cold gases ($30 \lesssim T \lesssim 1.5 \times 10^4$ °K). It is found that some observable gas parameters (i.e., temperature, degree of ionization of hydrogen and heavy elements) could yield significant knowledge of the radiation field, as well as of other gas characteristics. For example, the absolute density and the abundance of heavy elements can be roughly deduced, and the degree of ionization of hydrogen can be determined from the ionization state of the heavy elements. In general, only the average energy of the ionizing photons can be inferred. (auth)

30629 BLUE BAND PHOTOMETRY OF CYGNUS X-1 DURING 1973. Walker, E. N.; Quintanilla, A. R. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 247-255(Nov 1974).

HDE 226868 (=Cygnus X-1) has been monitored in blue light during 1973. The 1973 light curve is of improved quality compared with the 1972 results. It does not confirm the evidence for an increasing amplitude found during 1972. The star was consistently brighter in 1973 by ~1 per cent. The trailing side of the Bo Ib star seems to be a site of photometric variability. (auth)

30630 HD 153919 = 2U 1700-37. Walker, E. N. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 47P-52P(Nov 1974).

The broad emission features in the optical spectrum of HD 153919 have been found to vary in strength with the x-ray flux. Evidence is presented which indicates that the effective temperature of the primary varies, having one minimum per orbit which coincides with one of the two photometric minima, the temperature minimum occurring on the side of the primary nearest to the x-ray source. The He I line λ 4471 develops a violet absorption wing once per orbit. (auth)

30631 NEBULOSITY ASSOCIATED WITH THE POWERFUL INFRARED AND RADIO SOURCE G333.6-0.2. Churms, J.; Feast, M. W.; Glass, I. S.; Harding, G. A.; Evans, T. L.; Martin, W. L. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 39P-40P(Nov 1974).

An emission nebulosity has been detected at the position of the infrared object in the H II region G333.6-0.2. The infrared and optical objects have about the same size (11 arcsec). The optical velocity is approximately the same as the H 109 α velocity. The optical object is probably heavily reddened. (auth)

30632 34.85 DAY CYCLE OF HER X-1. Davison, P. J. N.; Fabian, A. C. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 27P-29P(Nov 1974).

A 5½-day observation of Her X-1 is reported. At 05^h30^m UT, 1974 April 26 the turn-on was observed from the extended low of cycle 24. The turn-on of cycle 27 did not occur during a 1¾-day observing period in 1974 August. It is concluded that the basic $34^d.85$ cycle is not precisely predictable on the data so far available. (auth)

Solar Phenomena

30633 (AAS-74-164) COMET KOHOUTEK OBSERVATIONS FROM SKYLAB. Snoddy, W. C.; Barry, R. J. (American Astronautical Society, Tarzana, Calif.). 1974. 27p. (CONF-740839-1)

From 20th annual AAS skylab results meeting; Los Angeles, California, USA (20 Aug 1974).

During the SL-4 mission from November 16, 1973, to February 8, 1974, the comet was observed on over 100 occasions. The most significant observations were the evolutionary development of the hydrogen halo as recorded in Lyman alpha, the dynamics of the comet-Sun interaction throughout perihelion passage, near-uv spectrometry, the photometric development of the comet, and the visual observation by the crew, particularly during the several days immediately following perihelion. (WDM)

30634 (CEA-R-4660) CALCULATION OF EXCITATION COEFFICIENT BY ELECTRON IMPACT. Kato, T. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de la Physique). Apr 1975. 13p. (In French). Dep. NTIS (US Sales Only) $4.00.

The method to calculate the collision excitation coefficient proposed by Mewe is discussed. The calculated values of oscillator strength Ω_M were compared by the method of Mewe (1972a) with theoretical and experimental values Ω which are more precise than the values of Mewe. One can say that Mewe's method is valid within factor of four, and that the mean value of Ω_M/Ω is 1.9. Also Mewe's value Ω_M was compared with the values $\Omega_{T\text{-}K}$ which Tucker and Koren (1971) calculated. (auth)

30635 (OAP-361) SOLAR MODELS WITH ROTATING CORES. Rood, R. T.; Ulrich, R. K. (Virginia Univ., Charlottesville (USA); California Univ., Los Angeles (USA); California Inst. of Tech., Pasadena (USA)). Jul 1974. 14p. Dep. NTIS $4.00.

Several workers have shown that it is possible to achieve low solar neutrino fluxes with solar models with rapidly rotating cores. However, to achieve a flux consistent with the 1 SNU (1 SNU = 10^{36} neutrino capture/target atom/sec) upper limit that Davis has set, the rotation must be so rapid that the approximate treatment of rotation employed is of doubtful validity. Further it is difficult to obtain a result simultaneously giving a flux less than 1 SNU and a solar oblateness consistent with observation. Sakurai has shown that it is possible for Eddington-Sweet circulation to transfer angular momentum both inward and outward in solar models with rotating cores on a time scale much less than the solar lifetime. Thus as the Sun evolves, its rotating core gets smaller while its outer part spins up. This suggestion has led us to investigate the possibility that this spin-up might lead to the onset of some transient phenomenon, e.g., the sudden beginning of thermal convection. It has been shown that under special circumstances, a transient state can lead to temporarily depressed neutrino fluxes. It was hoped that the transient phase induced by spin-up, coupled with an already depressed flux due to the rotating core would lead to a flux less than 1 SNU while requiring less extreme transients or rotation than is necessary when these effects are applied separately. In addition, a mechanism for the transient would be provided. Unfortunately, this hope has not been realized and additional problems with rotating solar models have been discovered. (auth)

30636 PLASMA ECHOES IN FLARES. Erokhin, N.S.; Kaplan, S.A.; Moiseev, S.S. (Khar'kov Technical Physics Institute, Academy of

Sciences of the Ukrainian SSR). Sov. Astron.—AJ 18: No. 4, 524-525 (Jan 1975).

The initial phase in the development of a chromospheric flare, with small "mottles" appearing almost simultaneously at different points, can be interpreted as a plasma-echo effect. (auth)

30637 THEORY OF LOOP PROMINENCES. Sasorov, P.V. (Moscow Physicotechnical Institute). Sov. Astron.—AJ 18: No. 4, 471-474 (Jan 1975).

The necessity of the injection of material from the chromosphere into loop prominences which occur after flares is often mentioned in the literature (refs. 1 and 2). A specific mechanism connected with the evaporation of the upper part of the chromosphere is proposed for this in the present work. This evaporation occurs through a sudden disturbance in the thermal balance at the base of the transitional layer of the corona-chromosphere which causes an increase in the heat flux through thermal conduction resulting from the sudden strong heating of the corona to $\sim 3\cdot10^7-10^8$°K. The corona can be heated to such temperatures because of the passage of a shock wave originating in the flare. The release of $\sim 10^{31}$ ergs of heat is required. The loop structure of the magnetic field plays the decisive role in this process. (auth)

30638 QUASI-ONE-DIMENSIONALITY OF PLASMA WAVE SPECTRUM IN TYPE III RADIO BURST SOURCES. Zaitsev, V.V. (Radiophysics Institute, Gor'kii). Sov. Astron.—AJ 18: No. 4, 475-481 (Jan 1975).

A number of experimental data point to the quasi-one-dimensionality of the spectrum of plasma waves excited in the sources of solar type III radio bursts. The conditions of the generation of such quasi-one-dimensional spectra during the generation of type III bursts by unstabilized electron streams are examined in this work. It is shown that Cerenkov excitation of plasma waves in the magnetic field of the corona, which leads to the formation of a one-dimensional plateau in the distribution function of the electron stream and to the formation of a quasi-one-dimensional plasma wave spectrum through the angular anisotropy of the increment, plays the principal role in the first stage of development of the stream instability. Subsequently the plateau can be unstable relative to the generation of the low-frequency branch of plasma waves and whistlers owing to the anomalous Doppler effect. However, if the stream concentration is not very high ($n_s < 4\cdot10^2$ for the lower corona and $n_s < 3\cdot10^{-3}$ for the upper corona at distances of $R \simeq 30R_\odot$) these instabilities are suppressed through collisional and Cerenkov dissipation in the solar corona, which leads to retention of the plateau and the quasi-one-dimensionality of the spectrum of high-frequency plasma waves in the process of escape of the stream from the flare region. (auth)

30639 COMPARISON OF RESULTS OF RADAR STUDIES OF THE CORONA WITH SOLAR ACTIVITY. Gerasimova, N.N. (Institute of Radiophysics and Electronics, Academy of Sciences of the Ukrainian SSR). Sov. Astron.—AJ 18: No. 4, 482-485 (Jan 1975).

The absence of a stable correlation between the effective cross section and the average characteristics of the solar activity was found in a comparison of the results of the radar studies of the corona with the activity of the sun. It is shown that large cross sections are connected with the passage across the disk of a flare-active sun-spot group of complex structure. A close correlation is found between the effective cross section and the number of type III bursts and the continuum connected with type III bursts and in some cases type I bursts. The maximum of the cross sections may not coincide with the time of passage of the sunspot group across the central meridian. Sudden large increases in the effective cross section were accompanied by type II bursts with a subsequent type IV continuum and a large number of type III bursts. The high reflectivity of the solar corona is connected with the relatively short time of development of the active region. (auth)

30640 PROBLEM OF THE DYNAMIC H II ZONE NEAR THE SUN. Ayubasheva, S.I.; Gidalevich, E.Ya. Sov. Astron.—AJ 18: No. 4, 486-487 (Jan 1975).

The ionization of the interstellar gas in the vicinity of the sun is calculated in this article, with allowance for the sun's peculiar motion. It is shown that in moving with a velocity of 20 km/sec relative to the interplanetary gas the sun forms an H II zone strongly elongated in the direction of the antapex. The energetic balance in this H II zone is determined by the energy influx through acts of ionization and the energy expenditure on the excitation of metastable levels and the charge exchange process. The electron and ion temperature distributions in the direction of the apex are found. (auth)

30641 DETECTION OF CORONAL HOLES FROM λ5303 Fe XIV OBSERVATIONS. Fisher, R.; Musman, S. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories). Astrophys. J. 195: No. 3, 801-803 (1 Feb 1975).

We use photoelectric measurements of intensity to estimate the distribution of volume emissivity in the coronal green line (λ5303 Fe XIV) over the solar surface. Using this distribution and a calculated dependence of emissivity as a function of T and N_e it is possible to estimate a coronal density distribution. An example is given which shows a region of drastically reduced emissivity—a coronal hole—which was simultaneously detected by spacecraft. (auth)

30642 MEASUREMENT OF THE ANGULAR MOMENTUM OF JUPITER AND THE SUN BY USE OF THE LENSES–THIRRING EFFECT. Haas, M. R.; Ross, D. K. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). Astrophys. Space Sci.; 32: No. 1, 3-11(Jan 1975).

The feasibility of using the Lense–Thirring effect to measure the rotational angular momentum of Jupiter and the Sun is investigated. This experiment uses gyroscopes in close Jovian and solar orbits. It is important because it provides direct, unique information. The angular momentum is not derivable from the gravitational moments when nonuniform rotation is present. Analysis shows that this experiment could be done around Jupiter with current technology, but could not be done around the Sun for some years. (auth)

30643 SOLAR CYCLE VARIATION OF THE SOLAR WIND HELIUM ABUNDANCE. Ogilvie, K. W. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 79: No. 31, 4595-4602(1 Nov 1974).

The experimental evidence for a variation of the relative abundance by number $h = n\alpha/np$ of helium in the solar wind is surveyed critically. The abundance is found to vary by $\Delta h = 0.01 \pm 0.01$ from 0.035 to 0.045 over solar cycle 20. The change in the average bulk speed during the solar activity cycle was insufficient to account for this increase in $\langle h \rangle$ with the solar cycle. The slope of the linear relation between h and the plasma bulk speed is also found to vary, being greatest around solar maximum. An attempt is made to explain the 30% variation in $\langle h \rangle$ as the result of the variation in the number of major solar flares over a solar cycle. These obvious transients are apparently not numerous enough to explain the observed variation, but the reasonable expectation remains that the transients observed recently by Skylab, which occur more frequently than major flares, could augment those associated with major flares. Since the solar wind flux is not observed to increase at solar maximum, the abundance of helium cannot be proportional to the proton flux leaving the sun unless the solar wind comes from a smaller area of the sun at maximum than at minimum. (auth)

30644 MASS EJECTIONS FROM THE SUN: A VIEW FROM SKYLAB. Gosling, J. T.; Hildner, E.; MacQueen, R. M.; Munro, R. H.; Poland, A. I.; Ross, C. L. (National Center for Atmospheric Research, Boulder, CO). J. Geophys. Res.; 79: No. 31, 4581-4587(1 Nov 1974).

More than 30 instances of sudden mass ejections from the sun were observed with the white light coronagraph experiment aboard Skylab during the first 118 days of the mission. Typically, these ejections appear as large magnetic loops rooted at the sun, yet expanding outward through the solar corona at speeds of the order of 400 km s^{-1}. The loops always appear to retain their magnetic connection to the sun. Eighteen of these ejections were associated with active and eruptive prominences and surges; only three ejections appear to have been flare initiated. Associations with ground-detected metric wavelength type 2 and 4 radio bursts occur for about 30% of these events; however, ground-detected type 2 and 4 radio bursts originating near the limb are almost invariably accompanied by coronagraph-observed ejections. Pressure or MHD waves run out ahead of the transient material ejecta; at times these waves can be detected by their effects on nearby coronal structures. For one event, that of August 10, 1973, we make the following estimates: (1) mass content, 4×10^{15} grams; (2) mass flow rate, 1.1×10^{12} grams s^{-1}; (3) energy content, 8.4×10^{30} ergs; and (4) energy flow rate, 7.7×10^{26} ergs s^{-1}. Locally, this represents a significant mass and energy input to the solar wind; we suggest that the ejections are the coronal counterparts of nonrecurrent (including shocks) solar wind disturbances detected near the orbit of the earth. (auth)

30645 OBSERVED STREAMER CURVATURE IN THE OUTER SOLAR CORONA. Wilson, D. C.; MacQueen, R. M. (National Center for Atmospheric Research, Boulder, CO). J. Geophys. Res.; 79: No. 31, 4575-4580(1 Nov 1974).

The first observations of coronal streamers to an elongation angle of 12.5° (50 R_s from sun center) were taken aboard the Apollo 15 command module in lunar orbit. Streamer curvature in both heliocentric latitude and heliocentric longitude may be determined from the positions of three curved streamers. This curvature is interpreted by assuming that it is not transient and that streamers trace flow from a stationary position on the solar surface. The azimuthal curvature is explained by corotation of streamer material with the sun out to approximately 25 R_s, followed by a constant radial velocity of 275 km/s and force free flow to 60 R_s. The curvature toward the solar equator implies a

meridional flow of 45 ± 15 km/s between 50 and 60 R_s. If constant angular momentum is assumed beyond 60 R_s, the resultant azimuthal and meridional velocities are consistent with the solar wind observed at 1 AU. The radial velocity, including a small expected acceleration between 60 R_s and 1 AU, is typical of slow-speed solar wind. Streamer curvature is compared with interplanetary magnetic field models. (auth)

30646 COMMENT ON "MOTION OF THE SOURCES FOR TYPE 2 AND TYPE 4 RADIO BURSTS AND FLARE-ASSOCIATED INTERPLANETARY DISTURBANCES" BY K. SAKURAI AND J. K. CHAO. Lanzerotti, L. J. (Bell Labs., Murray Hill, NJ). J. Geophys. Res.; 79: No. 31, 4823-4826(1 Nov 1974).

The paper by Sakurai and Chao (1974) in which an attempt is made to relate specific solar features to specific geomagnetic occurrences (namely, AAC) is discussed. A reply by Sakurai is included. (WDM)

30647 OBSERVED DEFLECTION OF LIGHT BY THE SUN AS A FUNCTION OF SOLAR DISTANCE. Merat, P. (Institut Henri Poincare, Cedex, France); Pecker, J. C.; Vigier, J. P.; Yourgrau, W. Astron. Astrophys.; 32: No. 4, 471-475(Jun 1974).

A detailed analysis using modern computing methods of all known measurements of the deflection of light near the solar limb shows a) the validity of Einstein's prediction beyond a certain distance of the Sun b) the possible existence of a new effect in the close vicinity of the solar limb which can be interpreted as resulting from a dispersive medium emitted by the solar surface. (auth)

30648 INTENSITY GRADIENTS AND ELECTRON DENSITY IN THE SOLAR CORONA. Rozelot, J. P.; Noens, J. C. (Observatoire du Pic du Midi, Toulouse). Astron. Astrophys.; 32: No. 4, 453-455(Jun 1974). (In French).

The height gradient of coronal emission lines enables one to determine the electron density in the solar corona. A dependence of the gradient on the intensity is shown and a method is given to obtain three important parameters: vertical density gradient (g), longitudinal extension (m), and density at the bottom of the studied enchancement (C). Two upper limits owing to the limitations of the method are found, which are: Fe XIV (5303 Å) $g < 7.5$ ($R_\odot$) and $m < 3.7$ ($R_\odot$), Fe XI (7892 Å) $g < 9.9$ ($R_\odot$) and $m < 4.9$ ($R_\odot$). An application of the method is given. (auth)

30649 STRUCTURE OF THE QUIET CORONA NEAR QUIESCENT PROMINENCES. FORT, B.; Martres, M. J. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 33: No. 2, 249-255(Jul 1974).

Monochromatic images of the solar corona in the light of the red and green lines of Fe X and Fe XIV respectively, obtained at the Pic-du-Midi Observatory, enable the geometrical structure of the quiet corona to be determined in the region of quiescent prominences, observed in Hα. Prominences and filaments are the same object and have a planar geometry. Coronal red line structures are observed to be similar in form to neighboring prominences, while coronal green line structures seem complementary to those observed in the red line. The coronal material has a geometry similar to that of the prominence, i.e., planar, and in the same plane as the prominence. The electron density of the emitting region is estimated from the results of a photometric analysis of the red and green line images. Some of the implications of the existence of "sheets of matter" in the quiet corona are discussed with particular reference to current ideas on coronal cavities. (auth)

30650 DYNAMICS OF CIRCUM-SOLAR DUST GRAINS. Lamy, P. L. (Cornell Univ., Ithaca, NY). Astron. Astrophys.; 33: No. 2, 191-194(Jul 1974).

The inward spiraling of interplanetary dust grains under the Poynting–Robertson and corpuscular pressure drags is shown to be either counterbalanced or reduced by the effect of the net increase of the radiation pressure force caused by the decrease of the grains' radii when sublimating. Precise trajectories, obtained for the first time, show that silicate grains remain in the vicinity of the Sun where they describe an impressive number of orbits. Dynamical dust-free zones are clearly established and the location of regions of probable concentration are predicted; infrared emission spectra show remarkable features which can serve as signatures for the nature of the dust. It is also concluded that grains whose radii are less than about 0.2 μm play a negligible role in the F-corona. (auth)

30651 NUMBER DENSITY OF IONS IN EXCITED STATES: CASE OF Fe XI. Rozelot, J. P.; Noeens, J. C.; Pech, B. (Observatoires du Pic-du-Midi, Toulouse). Astron. Astrophys.; 33: No. 3, 469-470(Jul 1974).

The density ratio N_i/N for levels belonging to highly ionized elements may be expressed as a power law in N_e under coronal conditions. The computations presented here concern Fe XI. The results are tabulated as a function of the dilution factor. It should be noted that the calculations are valid, for the electron density range 10^7 and 10^{10} cm^3. The calculations are useful to determine which lines are the most sensitive to electron density changes associated with the solar activity. (auth)

30652 STUDY OF He I EMISSION LINES IN THE SOLAR ATMOSPHERE. III. The Chromospheric 10830 A and 20581 A Lines Observed at the Eclipse of June 30, 1973. Streete, J. L. (High Altitude Observatory, Boulder, CO); Tandberg-Hanssen, E. Astron. Astrophys.; 33: No. 3, 385-387(Jul 1974).

During the June 30, 1973 eclipse the 1 μ and the 2 μ regions of the chromospheric spectrum were observed with an all-reflective coronagraph/spectrometer in order to determine the helium triplet/singlet line-intensity ratio, I(10830)/I(20581). A lower limit of 60 was found for this ratio, indicating a relative overpopulation of the triplet 2^3P level. (auth)

30653 CORONAL ELECTRON DENSITY AND TYPE III BURST THEORY. Boischot, A. (Observatoire de Meudon, France). Astron. Astrophys.; 33: No. 3, 379-380(Jul 1974).

The density in the corona derived from the study of Type III burst source positions is shown to be of the same order of magnitude, whether it is assumed that the emission is at the fundamental or at the harmonic of the plasma frequency. On the other hand, this density depends very much upon the assumed characteristics of the propagation of the waves in the corona. (auth)

30654 SOLAR Fe II λ 3969.4 DISK EMISSION LINE. Lites, B. W. (Observatoire de Geneve). Astron. Astrophys.; 33: No. 3, 363-365(Jul 1974).

The recent identification by Engvold and Halvorsen (1973) of the solar Fe II emission feature at λ 3969.40 is confirmed through line profile synthesis from kinetic equilibrium computations. In sharp contrast to the photospheric origin of the emission in rare earth lines in the H and K line wings, the Fe II line emission appears to be of chromospheric origin. It is suggested that this line could be used as another indicator of conditions in the low chromosphere, for example in plage regions near the limb. (auth)

30655 RELATIVE INTENSITIES OF THE LYMAN LINES OF HYDROGEN-LIKE OXYGEN, MAGNESIUM, AND SILICON IN THE SOLAR CORONA. Rugge, H. R. (Aerospace Corp., Los Angeles); Walker, A. B. C. Jr. Astron. Astrophys.; 33: No. 3, 367-371(Jul 1974).

Observations of the relative intensities of the Lyman lines of hydrogen-like O VIII, Mg XII, and Si XIV in the solar corona were made by satellite-based x-ray crystal spectrometers and are reported here. A comparison between the experimentally observed values of the intensity ratio of the Lyman α to the Lyman β line (Lyman ratio) was made with the recent theoretical predictions of this ratio by Hutcheon and McWhirter for low density plasmas. Good agreement was found between the theory and observations for those times for which a valid coronal temperature model was derived and applied to the temperature-dependent theoretical ratio. Observations made at times of greater solar activity appear to be inconsistent with the theory. (auth)

30656 KARHUNEN–LOEVE SERIES EXPANSION: A NEW APPROACH FOR STUDYING ASTROPHYSICAL DATA. Pelat, D. (Observatoire de Meudon, France). Astron. Astrophys.; 33: No. 3, 321-329(Jul 1974).

Karhunen–Loève series provide a new tool to study large quantities of data or records. This method gives very good results in data compression, but also performs a statistical analysis and allows an interpretation of records. This paper presents two parts: Part A is devoted to the theory of this technique and Part B shows a study of Type I radiobursts by means of this method. (auth)

30657 HEAVY SOLAR COSMIC RADIATION. Hovestadt, D. (Max-Planck-Institut fuer Physik und Astrophysik, Garching/Muenchen (F. R. Germany). Inst. fuer Extraterrestrische Physik). Naturwissenschaften; 61: No. 7, 281-287(Jul 1974). (In German).

During solar flares heavy solar cosmic rays ($Z > 2$) are observed along with protons, alpha particles, and electrons. New experimental techniques have recently made the low-energy part ($E < 8$ MeV/nucleon) of the energy spectrum accessible to observation. At these low energies the heavier elements (Fe) are more abundant than the lighter elements (C, O); this finding contrasts with the relative abundance of the elements on the sun and in high-energy solar cosmic rays. Heavy elements generally seem to be highly ionized, even at low energies ($E < 1$ MeV/nucleon). (auth)

30658 TIME VARIATIONS IN THE BACKGROUND ELECTRON FLUX AT ENERGIES $40 \leq E_e \leq 500$ keV. Zel'dovich, M. A.; Kuzhevskii, B. M.; Logachev, Yu. I.; Lutsenko, V. N.; Savenko, I. A.; Shestopalov, I. P. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 572-575(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 628-632(1974).

Electron time variations were studied with an instrument designed for investigating a low flow of electrons at energies in the range $40 \leq E_e \leq 500$ keV. This instrument was carried by the Prognoz earth satellite launched April 14, 1972. Two periods of weak solar activity were selected for examining the background electron flux: May 18–28 and June 28–July 19, 1972. The time dependence of the electron flux density (Prognoz), solar-wind velocity (Pioneer 6, 8, and 9), solar-activity indices, and intensity of solar x rays are shown. The electron flux density has been averaged over 8-h intervals, and the increases in the flux upon passage through the magnetosphere have been excluded. The x-ray flux has been averaged over 12-h intervals, with bursts of x rays excluded. It is shown that during the period in question a background flux of low-energy electrons was continually present in interplanetary space. Evidently these particles are constantly being generated on the sun. Quiescent periods, when the electron background remains at the same level, are observed for no more than a few days. At other times the intensity of the background electron flux varies by several times. The minimum electron flux was recorded on July 14, and the background remained at about the same level for several days (July 16–19). The value of this minimum flux density was 0.7 ± 0.05 particle $\cdot$ cm^{-2} $\cdot$ sec^{-1} $\cdot$ sr^{-1}. Evidence that electrons with energies $E_e \gtrsim 40$ keV are solar is provided by the positive correlation of the electron flux with both the solar-wind velocity and the level of x rays. (MHR)

30659 NINETEENTH-CENTURY CORONAL TRANSIENT. Eddy, J. A. (National Center for Atmospheric Research, Boulder, CO). Astron. Astrophys.; 34: No. 2, 235-240(Aug 1974).

The remarkable coronal transients seen in white light by the coronagraph on Skylab suggest a search for such features in past eclipse records. An unusual feature observed in the corona during the 1860 total solar eclipse appears to be a very likely predecessor. Sketches and firsthand reports reveal the circumstances of its development, motion, and physical characteristics and indicate that it was a relatively subtle feature to the naked eye. Unlike the events seen with present orbital coronagraphs, the 1860 event occurred at solar maximum. (auth)

30660 CHROMOSPHERE-CORONA TRANSITION REGION AS SEEN IN C III. Loulergue, M. (Observatory, Meudon, France); Nussbaumer, H. Astron. Astrophys.; 34: No. 2, 225-233(Aug 1974).

An analysis of the C III lines at 977 Å and 1176 Å shows that the electron pressure of part of the chromosphere-corona transition region cannot support the coronal gas pressure. The missing pressure could be supplied by turbulence of which spectral line widths show evidence, but also by the general magnetic field. It is found that the transition region must have an extension of several thousand km instead of the usually accepted few hundred km. It is also shown that C III has a real chance of being effectively emitted over a large range of electron temperatures, $30{,}000\ \mathrm{K} < T_e < 100{,}000$ K, and not only close to some "most effective T_e" as often assumed. The optical depth in the resonance line λ 977 is found to be approximately 1, but there is a high probability for the absorbed photon to be immediately reemitted, thus the optical depth should not influence the total intensity. It is found that coronal densities may already prevail in the transition region. (auth)

30661 TIME DEVELOPMENT OF CIRCULAR POLARIZATION SOLAR MICROWAVE BURSTS. Kaufmann, P.; Marques dos Santos, P. (Universidade Mackenzie, Sao Paulo, Brazil). Astron. Astrophys.; 34: No. 2, 197-201(Aug 1974).

The investigation of time development of circular polarization of solar microwave bursts is briefly reviewed. An accurate analysis of a complex burst permitted the characterization of some typical effects. The departure of polarization degree began about a minute before the event and a rapid peak prior to the flash phase coincided with the beginning of a Type III event in the solar corona. It could be explained by assuming a sudden change in the characteristic scale of the magnetic field at the emitting region. Other peaks in polarization similarly precede the peaks in intensity. Such peaks seem to be superimposed over a slow rise in circular polarization that attained a maximum when a Type II event started higher in the corona, suggesting that the slow development of the polarization with time could be associated with shock wave produced in the original explosion. The polarization effects can be discussed with the use of existing models for solar active regions, providing interesting information on flare onset, trigger and time development phenomena, as well as some clues on the physical links between microwave and metric transient solar radio emission. (auth)

30662 SHORT-PERIOD OSCILLATIONS IN THE SOLAR X-RAY RADIATION. Jakimiec, J.; Jakimiec, M. (Univ., Wroclaw). Astron. Astrophys.; 34: No. 3, 415-417(Sep 1974).

Quasi-periodic oscillations of the 1 to 8 Å solar x-ray radiation have been found. The power spectrum of the oscillations is variable; the periods fall within the limits of 200 to 900 s. The similarity of the properties of the oscillations to those in cm radio emission and magnetic field measurements is emphasized. (auth)

30663 CENTER-TO-LIMB ANALYSIS OF SOLAR Mg II LINES. Gouttebroze, P.; Lemaire, P. (Laboratoire de Physique Stellaire et Planetaire, Verrieres le Buisson, France). Astron. Astrophys.; 34: No. 3, 375-386(Sep 1974). (In French).

Center-to-limb variations of Mg II resonance line profiles, deduced from balloon spectra of the Sun, are studied. Limb-darkening in the line wings agrees satisfactorily with frequency independent source functions and Voigt profiles for line absorption coefficients. Estimates of Doppler widths from a line core analysis show a rapid increase of turbulence velocities with height. The source functions of the two lines are found to be unequal at the same geometrical depth, which suggests that collisional coupling between fine-structure levels (3p) is weak. Apparent source function variations with frequency are found in the spectral interval [0.2, 0.5 Å] from line center; several possible explanations of this fact (partially coherent scattering, geometrical and dynamical effects) are discussed. (auth)

30664 ANGLE-AVERAGED REDISTRIBUTION FUNCTIONS IN NONCOHERENT SCATTERING. Magnan, C. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 35: No. 2, 233-236 (Oct 1974).

It is shown that when the redistribution function is averaged over angle in a non-local frame of reference, a very large artificial emission in the wings of the profile occurs. It is concluded that the effects found recently by Vardavas (1974) and Cannon and Vardavas (1974) are in fact unreal. They are essentially due to a bad choice of the reference frame. (auth)

30665 POSSIBILITY OF SPECTRAL CLASSIFICATION OF STARS BY THEIR ULTRAVIOLET SPECTROGRAMS. Gurzadyan, G. A. (Garni Space Astronomy Lab., Erevan). Astron. Astrophys.; 35: No. 3, 493-494(Oct 1974).

It is shown that the form and extent of the ultraviolet spectrograms of stars taken by a telescope with an objective prism and in the wavelength region shorter than 3000 Å up to 2000 Å depend on the spectral class of stars. A method is suggested for the spectral classification of stars by their continuous spectrograms in the ultraviolet. The method may prove particularly effective for faint stars. (auth)

30666 HELIUM ABUNDANCE AND PHYSICAL CONDITIONS IN THE 30 DORADUS NEBULA. Huchtmeier, W. K.; Churchwell, E. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 35: No. 3, 417-420(Oct 1974).

From new observations of H 109α and He 109α line intensities in 30 Doradus, an ionized helium abundance between 5 and 8% by number was found. The lines were about twice as broad as those from typical galactic H II regions (excluding the galactic center region) and showed no indication of blended multiple line components. Non-LTE effects were found to be <5% in the low density gas of the nebula. Implications with regard to the ionization of 30 Doradus are discussed. (auth)

30667 REDUCTION OF SOLAR NEUTRINO FLUX BY VARIABLE FERMI COUPLING CONSTANT AND HIGH ^{3}He ABUNDANCE. Shaviv, G. (Tel-Aviv Univ., Israel). Astron. Astrophys.; 35: No. 3, 385-388(Oct 1974).

Two recently suggested hypotheses for the explanation of the disagreement between theory and observation of the solar neutrino flux are discussed. It is shown that the two theories, namely the dependence of the weak interaction coupling constant on the gravitational potential and a high initial abundance of ^{3}He cannot reduce the predicted neutrino flux to below the present day upper limit. (auth)

30668 CHARACTERISTICS OF SOLAR NORTH POLAR CAP RADIO EMISSION AT LAMBDA = 4.3 CM BASED ON 24 DECEMBER 1973 ECLIPSE OBSERVATIONS. Kaufmann, P.; Marques dos Santos, P. (Universidade Mackenzie, Sao Paulo, Brazil). Astron. Astrophys.; 35: No. 3, 459-461(Oct 1974).

The partial eclipse covered the Sun's north polar cap. No circular polarization effect was measured, and limb darkening was noted. A simple model is proposed for the brightness temperature distribution towards the polar regions. (auth)

30669 BROAD-BAND CIRCULAR AND LINEAR POLARIZATION IN SUNSPOTS: CENTER-TO-LIMB VARIATION. Illing, R. M. E.; Landman, D. A.; Mickey, D. L. (Univ. of Hawaii, Honolulu). Astron. Astrophys.; 35: No. 3, 327-331(Oct 1974).

Observations of broad-band circular and linear polarization in sunspots is presented with a view to elucidating the physical mechanisms responsible. Particular emphasis is given to the

center-to-limb variations in an isolated, geometrically regular spot. (auth)

30670 CYCLIC VARIATIONS OF DENSITY AND TEMPERATURE IN THE CORONA. Leroy, J. L.; Trellis, M. (Observatoire du Pic-du-Midi, Toulouse). Astron. Astrophys.; 35: No. 2, 289-291(Oct 1974). (In French).

Coronal observations obtained at Pic-du-Midi Observatory over three solar cycles of monochromatic measurements and one cycle of K-corona studies have been previously published (Leroy and Trellis, 1974). This set of data is used for a study of the variation through the solar cycle of the main physical parameters which govern the lower corona. The average density and the hydrostatic temperature are deduced from K-corona measurements. Then, from a hypothesis about the distribution of temperatures along the line of sight in an average corona, the monochromatic intensities are computed which should be observed in the λ 5303 and the λ 6374 Å lines if the corona were homogeneous. Differences between observed and computed intensities of lines is interpreted in terms of inhomogeneities in the corona, that are expressed by a "filling coefficient" 1/k, and also by variations of the ionization temperature along the line of sight. It is found that k, which is always greater than 2, displays a cyclic variation with a maximum just before the minimum of activity. As a result, local densities appear to be about 5 times larger than average densities, ranging from 10 to 30×10^8 electrons/cm^3. On the other hand, the deduced ionization temperature is in rather good agreement with the computed hydrostatic temperature, for the time of minimum activity ($T \simeq 1.2 \times 10^6$ °K) while the average temperature variation through the cycle appears to be of the order of 0.4×10^6°K. (auth)

30671 THREE ACTIVITY CYCLES IN THE LOWER CORONA. Leroy, J. L.; Trellis, M. (Observatoire du Pic-du-Midi, Toulouse). Astron. Astrophys.; 35: No. 2, 283-288(Oct 1974). (In French).

A synoptic description is given of observations performed on a survey basis at Pic-du-Midi Observatory since 1944 for monochromatic measurements and, since 1964, for K-corona studies. First the stability of the Pic-du-Midi photometric system is studied for monochromatic measurements, once the intensity scale has been transformed in order to eliminate a small non-linearity near the origin; a comparison with data from other observatories is given. Same care is given to K-corona measurements and, finally, three synoptic maps based upon annual averages are drawn which cover three solar cycles for monochromatic measurements and one cycle for the K-corona. It is shown that there is a nearly linear relation between the integrated intensity of the K-corona for low latitude regions and the Wolf number, while the behavior of the λ 5303 Å line is rather different with relatively higher intensities before the end of the cycle. (auth)

30672 INTERACTION OF INTERPLANETARY DUST GRAINS WITH THE SOLAR RADIATION FIELD. Lamy, P. L. (Cornell Univ., Ithaca, NY). Astron. Astrophys.; 35: No. 2, 197-207(Oct 1974).

The interaction of interplanetary dust grains with the solar radiation field is investigated for micronic and submicronic spheres of quartz, obsidian, andesite, ice and iron. The dependence of the complex indices of refraction on wavelength was taken into account using Mie theory to obtain the efficiency factors for absorption and radiation pressure. The temperature distributions differ markedly from past results, and show that silicate grains can come very close to the Sun, thus justifying the existence of a dusty component of the solar corona up to approximately 2 $R_\odot$. Improved vapor pressure formulae yield increased lifetimes for interplanetary grains. It is shown that the onset of rapid destruction by sublimation is extremely sudden and has a well-defined location which depends upon the absorption character of the grain's material. Finally, the radiation pressure force never exceeds the gravitational force for silicates and ice—a result which contradicts general belief; it does so for iron, but only for a narrow range of values of the grain's radius. These results call for a new investigation of the dynamics of interplanetary dust particles. (auth)

30673 STEADY AND OSCILLATORY $\alpha\omega$-DYNAMOS. Deinzer, W.; von Kusserow, H. U.; Stix, M. (Goettingen Univ., Ger.). Astron. Astrophys.; 36: No. 1, 69-78(Nov 1974).

Using the model of Deinzer and Stix (1971) of an $\alpha\omega$-dynamo the problem is investigated whether the preferred magnetic field mode is steady or oscillatory for any particular strength and spatial distribution of the induction effects (α-effect and non-uniform rotation). It is found that a spatial separation of these two effects favors the steady modes, in contrast to an earlier assertion of Steenbeck and Krause (1969a). The steady modes have dipoletype symmetry if the dynamo number is positive, and quadrupoletype symmetry if the dynamo number is negative. The possible relevance of the steady dipole solutions to the dynamo operating in the Earth's interior is discussed. (auth)

30674 CENTER-TO-LIMB VARIATION OF THE SUN AT CENTIMETRIC WAVELENGTHS. Fuerst, E. (Max-Planck-Institut fuer Radioastronomie, Bonn); Hachenberg, O.; Hirth, W. Astron. Astrophys.; 36: No. 1, 123-133(Nov 1974).

Observations of the sun at 5GHz, 10.69GHz, 17GHz, and 24GHz are undertaken in order to determine more precise than it was possible before the center-to-limb variation of the brightness temperature. On account of randomly distributed brightness variations over the solar disk in this frequency range, the main problem is the determination of the quiet sun's level. The problem is solved approximately considering the frequency distribution of areas with a certain brightness temperature. It turns out that the center-to-limb variation up to about 65° heliographic longitude is less than about ±100K at 10.69GHz, less than ±90K at 17GHz and 24GHz. The center-to-limb variation is obviously very small within the frequency range between 10GHz and 30GHz. However, the observations at 5GHz indicate a strong limb brightening of approximately 3000K or more at 65° heliographic longitude. The small center-to-limb effect at low centrimetric waves implies that the lower part of the chromosphere-corona transition region should be inhomogeneous. The strong limb brightening at 5 GHz can be explained only if the brightness temperature of spicules depends on frequency. (auth)

30675 OBSERVATION OF THE SOLAR ULTRAVIOLET Mg II DOUBLET, (1). Kohno, T.; Yajima, N. (Mechanical Engineering Lab., Tokyo (Japan)); Suemoto, Z. Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 10: No. 1, Pt. B, 166-173(Mar 1974). (In Japanese).

The preliminary observation of solar ultraviolet Mg II doublet was performed with a spectrometer on a balloon. The spectrometer used was a supersmall monochromator with a plane diffraction grating of 600 lines/mm and the focal length of 150 mm. Scanning was performed for the wave length region of 2800 ± 50 Å. The control of following-up the sun was made by a servomotor which controlled a main concave mirror. On September 16, 1971, balloon flight was carried out at Sanriku, Japan. Level flight started at 10:57 am, and observation was made from 11:08 am for 4 hours. The regulation of the observation was made by command signals, and data were sent by a telemeter. Analysis of data was made on the intensity of radiation of 2800 Å and 2850 Å. Effect of absorption due to the atmosphere above the balloon was taken into consideration. This effect depends on the thickness of absorption layer, and is a function of the time of observation. The obtained transmission of solar radiation as a function of wave length is shown in a figure as well as the results by French group. The absolute intensity of the radiation of 2800 Å and 2850 Å was estimated by using transmission curves. The absolute solar radiation intensity at 2800 Å was 2.4 W/m^2/100 Å. (JA)

30676 OBSERVATION OF THE SOLAR ULTRAVIOLET Mg II DOUBLET, (2). Yajima, N.; Kohno, T. (Mechanical Engineering Lab., Tokyo (Japan)); Suemoto, Z. Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 10: No. 1, Pt. B, 174-182(Mar 1974). (In Japanese).

The observation experiment on solar ultraviolet Mg II doublet was performed on the basis of the results of preliminary experiment. The spectrometer used was the series combination of two Fabry-Pérot interferometers. It was aimed to follow up the direction of the sun within the angular error of ±5". A plane mirror reflects solar radiation and leads the radiation to a concave mirror. The focussed radiation is led to the spectrometer and a fine sensor which emits signals to drive a servomotor adjusting the direction of the plane mirror. The direction sensor is composed of a rough sensor and a fine sensor. Scanning of wave length is made by rotating the interferometers and changing incidence angle. The resolving power of the coupled interferometers is 0.03 Å. At each end of the cycle of scanning wave length, an ultraviolet monochromatic image is recorded by a motor driven camera. The position of a slit on the image of the sun is not fixed and moves successively at each end of scanning. The balloon flight of the interferometers was made on September 21, 1972. A telemeter did not work well from 9:00 am. It began to work well around 13:00, and sent data for about 2 hours. The gondola containing the interferometers and camera fell down 160 km offshore, accordingly it was impossible to recover them. The result of spectrum analysis was not good enough to give any meaningful conclusion. The accuracy of following-up the sun was 10 ~ 20", and a little worse than the aim of design. Further improvement for the next experiment is in progress. (JA)

30677 OBSERVATION OF THE SOLAR INFRARED SPECTRUM, (3). Tanaka, W.; Suemoto, Z. (Tokyo Univ. (Japan). Faculty of Science). Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 10: No. 1, pt. B, 201-209(Mar 1974). (In Japanese).

The observation of solar infrared spectra was performed with a balloon. The apparatus for the observation consists of a double axis sun follower, a solar aspectmeter, an infrared scanning nonchrometer and a synchronous amplifier. All the instruments were contained in a gondola. The sun follower is designed to regulate direction within ±1′. The solar sensor is composed of a rough sensor and a fine sensor. Both are made of solar batteries. Attention was paid for the coupling of the monochrometer and the sun follower. Previous observation was not successful because of the displacement of an optical axis due to temperature rise. The overall response function of the apparatus to wavelength is shown in a figure. Balloon flight was made on September 20, 1972. The balloon began level flight at 10:05 am. Observation was carried out from 10:35 am to 14:56 pm. The output of telemeter was recorded with a pen-recorder. Absorption line of water vapour was not seen on the trace. The absorption bands of CO_2 were observed at 1.96, 2.01 and 2.06 μ. The amount of atmosphere remaining between the sun and the apparatus was estimated to be 190 ~ 320 m-atm. Identification of spectral lines were made by using the Mohler's table. It was concluded that the observed spectrum was that of the center of solar photosphere. (JA)

30678 OBSERVATIONS OF PROMINENCES IN He II WITH A NEW 25 CM CORONAGRAPH. Hirayama, T.; Nakagomi, Y. (Tokyo Univ., Mitaka (Japan). Tokyo Astronomical Observatory). Publ. Astron. Soc. Jap.; 26: No. 1, 53-56(Mar 1974).

Spectroscopic observations of quiescent prominences obtained with a new coronagraph at Norikura are reported. He II 4686 and He I 4713 showed the same 1/e widths of 8 kms^{-1}. The kinetic temperature of the He II emitting region is found to be 6600 K, with turbulent velocity of 5 kms^{-1}. A brief description of the coronagraph is also given. (auth)

30679 OBLIQUITY OF THE ECLIPTIC TWO MILLENIA AGO. Newton, R. R. (John Hopkins Univ., Silver Spring, MD). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 331-342(Nov 1974).

From Hellenistic measurements of star declinations it is possible to infer the obliquity of the ecliptic at the mean epoch −114. The result is 23°43′06″ ± 3′19″. The value calculated from Newcomb's theory at the same epoch is 23°42′35″. (auth)

30680 EFFECTS OF CORRELATED TURBULENT VELOCITIES ON PHOTOSPHERIC LINE FORMATION. Gail, H. P.; Sedlmayr, E. (Univ., Heidelberg). Astron. Astrophys.; 36: No. 1, 17-25(Nov 1974).

The concept of stochastic turbulent fields is applied to line formation in the solar photosphere. The effect of a finite correlation length on the line profiles, the equivalent widths and the curves of growth is discussed. It is shown that for a correlation length which is smaller than the photospheric scale height both the line center and the outer wings of a line are formed approximately under microturbulent conditions. A comparison of the calculations with the observed profiles for the OI lines λ7771, λ7774 and λ7775 and for the Fe I lines λ5576, λ5934 and λ6200 gives correlation lengths of the order of 100−300 km and mean turbulent velocities of about 2 km/s. For the iron lines the analysis yields abundances which are smaller than the values obtained by previous authors by $\Delta \log gfe \simeq 0.4...0.6$. For the oxygen lines an abundance of $\log e_0 \simeq 8.70$ is confirmed. (auth)

30681 SOLAR MAGNETIC FIELDS. International Astronomical Union Symposium No. 43 Held at Paris, France, August 31−September 4, 1970. Howard, R. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Company (1971). 786p. (CONF-700868-; ISBN-90-277-0201-2). $42.00.

Topics discussed concern instrumentation for measuring magnetic fields in the solar atmosphere, the interpretation of magnetograph results concerning the formation of absorption lines in a magnetic field, observations of sunspot and active region magnetic fields, observations of magnetic fields associated with flares and other transitory phenomena, theories of small-scale magnetic fields, optical and radio observations of large-scale magnetic fields on the sun, the polar fields of the sun and the magnetic activity cycle, and theories of large-scale fields and the activity cycle. (IAA)

Galaxies

Refer also to abstracts 30496, 30587, 30601, and 30604.

30682 OH ABSORPTION IN THE DIRECTION OF THE GALACTIC CENTER. Lekht, E.E.; Aitova, G.A.; Rudnitskii, G.M. (P. K. Sternberg State Astronomical Institute). Sov. Astron.−AJ 18: No. 4, 403-404 (Jan 1975).

The results of observations of the OH 1667 MHz absorption line near the galactic center are reported. The observations were carried out at Nancay (France) with a high angular spectral resolution; six clouds were detected. An OH cloud with +40 km/sec radial velocity has been resolved into two components. The possible cloud structure is discussed. (auth)

30683 SOME DYNAMICAL EFFECTS EXPECTED FROM THE MOTION OF GALAXIES THROUGH A GASEOUS MEDIUM. Zasov, A.V. (Shternberg Astronomical Institute, Moscow). Sov. Astron.−AJ 18: No. 4, 426-427 (Jan 1975).

The motion of galaxies through an intergalactic medium could partially disrupt their interstellar-gas layer and result in the loss of gas from outlying regions. This process might explain the H I deficiency observed in galaxies of the Virgo cluster, the color excess found by Holmberg for Virgo spirals, and the characteristic asymmetry of the dust layer in certain galaxies. (auth)

30684 OBSERVATIONS OF GALACTIC NEBULAE AND THE SOURCE 3C 273 AT 3.87 MM. Efanov, V.A.; Kislyakov, A.G.; Kuznetsov, I.V.; Moiseev, I.G.; Troitskii, A.V. (Gor'kii Radiophysics Institute). Sov. Astron.−AJ 18: No. 4, 410-412 (Jan 1975).

Observations at λ = 3.87 mm are reported of the nebulae W 49, M17, M1, Cas A, and NGC 1976, as well as the quasar 3C 273. The measurements were made in October 1972 with the RT−22 radio telescope of the Crimean Astrophysical Observatory. For each source the angular size and radio flux density has been determined, with Jupiter, Saturn, and Venus serving for calibration purposes. (auth)

30685 LUMINOSITY FUNCTION OF NEARBY GALAXIES. Christensen, C.G. (Department of Physics and Astronomy, Brigham Young University, Provo, Utah 84602). Astron. J. 80: No. 4, 282-289 (Apr 1975).

The luminosity function of nearby field galaxies has been determined from a sample of 231 "normal" galaxies with $m_B \leq 11.85$. The sample has been confined to galactic latitudes above ±20 ° and excludes the Virgo cluster region. Absolute magnitudes for galaxies with radial velocities exceeding 400 km sec^{-1} have been based on the Hubble law with H = 50 km sec^{-1} Mpc^{-1}. Other distance criteria have been used for systems of lower velocity. For galaxies brighter than M_B = 21.05 the observed differential luminosity function is well represented by $\log\phi$ $(M_B) = (27.65 \pm 0.31) + (1.462 \pm 0.014)$ M_B. Fainter systems are described by $\log\phi$ $(M_B) = (4.37 \pm 0.44) + (0.355 \pm 0.004)$ M_B. Resolution of the luminosity function into eight morphological types reveals moderately strong dependence on type. The results of varying the Hubble parameter and the absorption law are demonstrated to be small except for a displacement of the entire function in the log ϕ, M_B plane. Including the Virgo cluster region is shown to unrealistically distort the bright end of the function. Northern and southern luminosity functions agree in shape but not in position in the log ϕ, M_B plane. Not all of the difference can be attributed to the higher galaxian density of the northern hemisphere. It may be that the asymmetry is only apparent, arising out of the peculiar motion of the Local Group. (auth)

30686 THE EJECTION OF MASSIVE OBJECTS FROM GALACTIC NUCLEI: GRAVITATIONAL SCATTERING OF THE OBJECT BY THE NUCLEUS. Saslaw, W.C. (University of Virginia). Astrophys. J. 195: No. 3, 773-781 (1 Feb 1975).

When a compact massive object moves through a galactic nucleus or stellar system, its gravity produces coherent fluctuations in the stellar density. The massive object is scattered by these self−induced fluctuations and deflected from its initial orbit. This process can be used to probe the gravitational response of stellar systems, and it may be related to the observed misalignment of double extragalactic radio sources. (auth)

30687 NUCLEAR MAGNITUDES FOR GALAXIES IN THE COMA AND PERSEUS CLUSTERS. Weedman, D.W. (Dyer Observatory, Vanderbilt University). Astrophys. J. 195: No. 3, 587-592 (1 Feb 1975).

Multiaperture *BV* photometry is presented for 72 galaxies in the Coma Cluster and 44 galaxies in the Perseuss Cluster using apertures from 4″.1 to 17″.0 in diameter. Apparent correlations similar to those reported by Tifft are found between the galactic nuclear magnitudes and galaxy redshifts in the Coma cluster but not in the Perseus cluster. We do not presently conclude that the data provide confirming evidence for noncosmological redshifts in these clusters. However, it is found that either the absolute nuclear magnitudes of the Perseus cluster galaxies are about 1 mag brighter than those of Coma or that the Coma cluster is more distant relative to Perseus than its redshift implies. (auth)

30688 INTERGALACTIC H I IN THE SCULPTOR GROUP. Mathewson, D.S.; Cleary, M.N. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University); Murray, J.D. Astrophys. J. Lett. 195: No. 3, L97-L100 (1 Feb 1975).

H I clouds have been found up to 1°.5 and 3°.5 from the galaxies NGC 55 and NGC 300, respectively, with velocities similar to the

systemic velocities of the two galaxies. They are probably intergalactic gas clouds in the Sculptor Group with linear projected distances of up to 80 kpc from NGC 55 and 180 kpc from NGC 300. A long tail of H I was also found extending 2° to the SE of NGC 300 along its major axis. This tail and similar H I tails on M83 and IC 10 lie approximately in the plane of the Local Supergalaxy; the Magellanic Stream also lies near the supergalactic plane. (auth)

30689 THE DETECTION OF INTERSTELLAR VINYL CYANIDE (ACRYLONITRILE). Gardner, F.F. (Division of Radiophysics, CSIRO, Sydney, Australia); Winnewisser, G. Astrophys. J. Lett. 195: No. 3, L127-L130 (1 Feb 1975).

Interstellar vinyl cyanide, $H_2C{=}CH{-}CN$, has been discovered in its $2_{11}-2_{12}$ (1372 MHz) transition in Sgr B2. The line is in emission with a peak antenna temperature of 0.036°K. It probably results from maser amplification of the continuum. The total molecular content is uncertain. (auth)

30690 THE 1400-MHz LUMINOSITY FUNCTION FOR ABELL CLUSTERS OF GALAXIES. Owen, F.N. (University of Texas Radio Astronomy Observatory, Austin, Texas). Astrophys. J. 195: No. 3, 593-603 (1 Feb 1975).

New observations have been used to derive the radio luminosity function of Abell clusters of galaxies at 1400 MHz. A relatively narrow, approximately Gaussian luminosity function is found. Correlations of detection probability with optical properties are examined. No strong correlation with cluster richness is found; however, a correlation of detection above a constant absolute luminosity with distance is detected. A correlation with Rood and Sastry cluster type is also found. The mutual relation of these correlations is discussed. The relation of the cluster luminosity function to field galaxies detections and previously derived radio luminosity functions is examined. The observations are found to agree well with the predicted shape and peak luminosity of a multiple source emission model of the cluster luminosity function; however, the amplitude of the model function is higher than the observed function by a factor of 3. The possible significance of the multiple source emission model is briefly discussed. (auth)

30691 ($V-K$) COLORS OF GALAXIES: STATISTICAL DIFFERENCES BETWEEN SPIRALS AND ELLIPTICALS AND THE COLOR-DIAMETER RELATION FOR ELLIPTICAL GALAXIES. Grasdalen, G.L. (Kitt Peak National Observatory). Astrophys. J. 195: No. 3, 605-610 (1 Feb 1975).

New K (2.2 μ) observations are presented for a survey of galaxies. These are combined with available measures of V-magnitude to form ($V-K$) colors. The ($V-K$) colors of bright elliptical galaxies are found to have a very small cosmic dispersion, while for a heterogeneous sample of spiral galaxies the dispersion is quite large. There is no evidence that the ($V-K$) color of bright ellipticals depends on absolute luminosity. The ($V-K$) color of elliptical galaxies is found to have a strong radial gradient. This conclusion is verified by detailed observations of M87. The relation of the ($V-k$) color to other metal-content indicators is briefly discussed. (auth)

30692 ROTATION PROPERTIES OF THE INFRARED SPIRAL GALAXY NGC 3675. van der Kruit, P.C. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 195: No. 3, 611-615 (1 Feb 1975).

Measurements of the rotation curve of NGC 3675 from slit spectra in three position angles are reported. There is no evidence for strong noncircular motions. The rotation curve rises steeply in the inner part, and the corresponding central concentration of mass might be related to the presence of the relatively strong infrared (and perhaps radio) source in the nucleus. The rotation curve is consistent with the presence of a rather massive (about 20 percent of the total mass) nuclear bulge, in agreement with the optical appearance. The mass-luminosity ratio is probably small. (auth)

30693 MODELS FOR THE INNER REGIONS OF THE GALAXY. I. An ELLIPTICAL STREAMLINE MODEL. Peters, W.L. III (The University of Texas at Austin). Astrophys. J. 195: No. 3, 617-629 (1 Feb 1975).

A new model is proposed for the inner regions ($R<4$ kpc) of the Galaxy. This model involves gas flowing along concentric elliptical streamlines such as might be caused by a barlike perturbation in the gravitational field of the inner regions of the Galaxy. It is found that such a model can produce not only the so-called 3 kpc arm and the 135 km s^{-1} arm features, but other high-velocity features as well. This model does not require a highly energetic explosion at the galactic nucleus as does the usual expanding spiral-arm model, because there is no net flow of matter out of the inner regions. This model suggests that the outer spiral-arm density wave might be associated with a barlike density wave, in the inner regions of the Galaxy. (auth)

30694 THE ELECTRON DENSITY IN THE DIRECTION OF ZETA OPH. Stecher, T. P.; Williams, D. A. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Astrophys. Space Sci.; 32: No. 1, 211-213 (Jan 1975).

It is shown that photoionization of vibrationally excited H_2 and photodissociation of the H_2^+ ions produced thereby constitute a significant electron production route in high uv flux situations. A significant fraction of the electron density in the directions of ξ Oph (~15 km s^{-1} cloud) deduced from observations may be expected to arise in this way. (auth)

30695 THE COLLAPSE OF SELF-GRAVITATING CLOUDS OF PURE HYDROGEN. Poeppel, W. G. L. (Instituto Argentino de Radioastronomia, Buenos Aires). Astrophys. Space Sci.; 32: No. 1, 175-196(Jan 1975).

Exploratory models of the collapse of spherical self-gravitating clouds are studied in relation to the problem of the formation of first generation star-systems. The masses which were considered are in the range of 83 to 5.2×10^{10} $M_\odot$. For simplicity, the assumed composition includes hydrogen only, which could be in the form of H, H_2, H^+, or H^-. Since the physical conditions that might have prevailed in a primeval nebula are not well known, rather simple initial conditions were chosen: The gas starts from rest and has initially a uniform temperature. The case of rather cool ($T_0 \sim 100$ K) neutral clouds with different initial ionization degrees is considered. Some of the initial density-distributions here considered are uniform while others are decreasing from the center outwards. The assumed initial values for the densities are 10^{-24} g cm^{-3}, except for one of the models, for which it is $\sim 10^{-26}$ g cm^{-3}. Several atomic processes within the gas, including physical-chemical reactions and the evaluation of radiative emission coefficients are considered. A system of differential equations is set up in order to evaluate the concentrations n_H, n_{H2}, n_{H^+}, n_{H^-}, and n_e as a function of time. The treatment makes possible the study of the cooling and heating properties of the gas. Furthermore, the dynamical, thermal and chemical evolution of the cloud can be followed during the collapse. The computations apply only to the optically thin stages. The models show the importance of a correct evaluation of the chemical reactions and dissipative mechanisms, which cannot be ignored in a realistic treatment of the collapse of self-gravitating clouds. The influence of the initial conditions on the dynamical and thermal properties during evolution are also analysed. (auth)

30696 A NUMERICAL STUDY OF LOCAL STELLAR MOTIONS. House, F. C.; Innanen, K. A. (York Univ., Toronto, Ontario (Canada). Dept. of Physics). Astrophys. Space Sci.; 32: No. 1, 139-151(Jan 1975).

The orbits of over 10,000 stars are integrated in a steady-state model of the Galaxy for a time 6.0×10^8 yr. Initially, the stars are placed randomly inside spheres of 500 pc and 50 pc radius and are given random velocities, such that the sample has a Maxwellian or a spheroidal velocity distribution. The spheres are placed at the Sun's distance from the galactic centre (10 kpc) and are given a circular velocity of 250 kms^{-1}. The mean velocities and dispersions of stars within 1 kpc of an "observer" moving at the circular velocity are calculated as functions of time. The quantities show a strong time-dependence with oscillations of period 10^8 yr. The oscillations are independent of the mass model and occur also in an inverse square force field. A vertex deviation of the velocity ellipsoid, an asymmetric drift and a K-effect occur as natural consequences of the oscillations. Attempts to apply the Oort method for density determinations in the galactic plane are also influenced by the oscillations. Spiral density waves appear to have a small effect on the motions of the test stars. (auth)

30697 SHOCK WAVE CASCADES AND THE FORMATION OF PROTOGALAXIES. Rumyantsev, A. A. (Leningradskij Politekhnicheskij Inst. (USSR)); Chernin, A. D. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). Astrophys. Space Sci.; 32: No. 1, L15-L18(Jan 1975).

In this letter, the question of how large-scale primeval motions could produce perturbations on the relatively small galactic scales is considered on the basis of the concept of hydrodynamic instability in shock waves. (NL)

30698 LABORATORY PLASMAS AND THE GALACTIC SPIRAL ARMS. Cataldo, J. C. (City Coll., New York (USA)); Skalafuris, A. J. (Democritus Nuclear Research Center, Athens (Greece)). Astrophys. Space Sci.; 32: No. 1, L11-L14(Jan 1975).

The aim of this letter is to draw attention to a plasma experiment which may clarify the physical origin of the galactic spiral arms. A Kelvin-Helmholtz instability has been observed in a rotating cylindrical plasma column which takes the form of two spiral arms. (auth)

30699 OBSERVATIONS OF INTERSTELLAR CH MICROWAVE LINE RATIOS. Rydbeck, O. E. H.; Ellder, J.; Irvine, W. M.; Sume, A.; Hjalmarson, A. (Onsala Space Observatory, Sweden). Astron. Astrophys.; 33: No. 2, 315-319(Jul 1974).

Emission line ratios for the three transitions of the ground state A-doublet of interstellar CH indicate significant departures from equilibrium (LTE) population ratios in H I regions, as well as in the direction of H II regions. Usually the lower satellite transition is enhanced and frequently is the strongest line. Thus far, absorption features have been observed only towards M 17, the Omega nebula. The dark dust clouds appear to exhibit LTE. (auth)

30700 EVOLUTION OF GALAXIES AND RELATED PARAMETERS. Bottinelli, L.; Gouguenheim, L. (Observatoire de Meudon, France). Astron. Astrophys.; 33: No. 2, 269-276(Jul 1974).

The integral properties of 131 galaxies for which hydrogen and total masses are available, are investigated in terms of evolution properties. It is definitely shown that the various morphological types cannot be accounted for by a decrease of the initial gas density in the protogalaxy when the morphological type goes from lenticular to irregular. The dispersion, within a given morphological type, of the total mass densities and of the H I mass to total mass ratios are correlated with the color indices of the galaxies, the reddest ones appearing denser and less hydrogen rich than the bluest. These results lend support to the theory by Searle et al. according to which the spread of colors of galaxies within a morphological type is due to different values of the rate of star formation. Decreasing values of the initial gas densities in a galaxy appear to account for decreasing color indices, and not for the various morphological types. (auth)

30701 ENCOUNTERS BETWEEN GALAXIES OF EQUAL SIZE. Lauberts, A. (Astronomical Observatory, Uppsala). Astron. Astrophys.; 33: No. 2, 231-240(Jul 1974).

This paper deals with gravitational interactions between two stellar systems of equal size. Each system is composed of a compact central part and a surrounding spherical halo, both of the same mass. Most of the attention has been devoted to slow, close encounters, which give rise to conspicuous deformations due to strong tidal interactions. It turns out that the internal energy usually increases (by up to 25%) at the cost of orbital energy. However, short-term variations in the inner energy may be of either sign, and even yield a negative net result for distant encounters. In cases of slow orbits a considerable fraction (~0.1) of the total mass is exchanged between the systems, or is completely lost. Comparison is also made with the "impulsive approximation," and it is concluded that the relative motions must be very rapid for this approximation to work well. (auth)

30702 POLYTROPIC SHEETS, CYLINDERS, AND SPHERES WITH NEGATIVE INDEX. Viala, Y. P. (Observatoire de Meudon, France); Horedt, G. Astron. Astrophys.; 33: No. 2, 195-202(Jul 1974).

The principal properties of plane-symmetric, cylindrical and spherical polytropes with negative polytropic index are derived. An extended summary is presented in the conclusions. (auth)

30703 RADIO OBSERVATIONS OF H II REGIONS IN EXTERNAL GALAXIES. I. H II Regions in M 33. Israel, F. P.; van der Kruit, P. C. (Sterrewacht, Leiden). Astron. Astrophys.; 32: No. 4, 363-374(Jun 1974).

Observations at 1415 MHz with the Westerbork Synthesis Radio Telescope of 67 H II regions or groups of H II regions in M 33 are presented. The analysis shows: 1. Apparently all H II regions brighter than 2.5×10^{-29} W m^{-2} Hz^{-1} have been detected. 2. The observed radio luminosity distribution indicates that an appreciable percentage of the total flux density of M 33 at 21 cm may be thermal. 3. Excluding NGC 595 and NGC 604 the excitation parameter distribution has a well-defined maximum at 210 pc cm^{-2}. This indicates that the larger H II regions are ionization bounded. 4. Both NGC 595 and NGC 604 consist of a dense core and an extended halo. Comparison with 30 Dor in the Large Magellanic Cloud shows that all three are qualitatively similar and have ionized gas masses of the order of 10^5 solar masses. 5. The radio flux density per unit area drops sharply at 2 kpc from the center; within this radius there is a marked maximum of high mass ($M \geq 5 \times 10^4$ $M_\odot$) H II regions. 6. The H II/H I ratio also shows a sharp decrease around 2 kpc; most H II regions occur in regions with relatively high surface densities of H I gas (hydrogen spiral arms). 7. When combined with Searle's (1971) Hα and Hβ flux densities, the radio results imply internal absorption up to 1.3m. 8. No point source was observed at the optical nucleus of M 33. The upper limit implies an intrinsic flux about 70 times weaker than that of Sgr. A. (auth)

30704 PHYSICAL STUDIES OF EMISSION REGIONS IN M 33. Comte, G.; Monnet, G. (Observatoires de Marseille). Astron. Astrophys.; 33: No. 2, 161-176(Jul 1974).

Photographic and spectrophotometric data are presented for bright H II regions, diffuse arm emission regions, and interarm general emission in the spiral galaxy M 33 (NGC 598). An excitation survey from plates taken through narrow-band interference filters centered on the lines [O I] 6300 Å, [O III] 5007 Å Hα and Hβ confirmed the excitation gradient found by Searle (1971). (WDM)

30705 ABSOLUTE SPECTROPHOTOMETRIC STUDY OF THE CONTINUOUS SPECTRUM OF THE ORION NEBULA. Hua, C. T. (CNRS, Marseille). Astron. Astrophys.; 32: No. 4, 423-428(Jun 1974).

Absolute data for the spectral region $\lambda\lambda$ 5000 to 3100 are deduced from the recent direct comparison between the energy distribution in the continuous spectrum of the central part of the Orion Nebula (NGC 1976) and the standard source previously compared to blackbody radiation. These results confirm a former spectrophotometric study of the nebula, i.e., values of the absolute gradients and Balmer discontinuity. Using models by Brown and Mathews, and the energy distribution in the Balmer continuum, the contribution of scattered light and the value of the electron temperature are derived. (auth)

30706 RISING AND FALLING MOTION OF GAS ABOVE THE SPIRAL ARM. Tosa, M.; Sofue, Y. (Nagoya Univ., Japan). Astron. Astrophys.; 32: No. 4, 461-464(Jun 1974).

Evidence is given for the existence of rising and falling motions of the neutral hydrogen gas in the space above the spiral arm. Systematic variations of the radial velocity of gas with galactic latitudes ($b = 0 - 20°$) are examined in detail with special regard to the Perseus arm. They are interpreted in terms of vertical motion of gas which is ejected out of the spiral arm in the z-direction and falls freely toward the galactic plane. The ejection velocity is estimated to be about 90 km/s. (auth)

30707 REMARKABLE BRIGHT DARK NEBULA IN CHAMAELEON. FitzGerald, M. P. (Ruhr Univ., Bochum, Ger.). Astron. Astrophys.; 32: No. 4, 465-468(Jun 1974).

A remarkable "Bright Dark Nebula" is reported at $l = 303.74$, $b = -15.95$. The following parameters are derived for it: Distance 500 pc; $z = 140$ pc; A_{pg} (centre) ≥ 3.7m; mass ~30 $M_\odot$. The rim is about 0.5m brighter than the background sky. The nebula is elliptical in shape with major axis 0.83 pc, and lies parallel to the galactic plane. It is ideally suited for radio observations of molecular lines. (auth)

30708 STUDY OF THE CENTRAL REGION OF M 31. II. Synthetic Models of Stellar Populations. Joly, M. (Observatoire de Meudon, France). Astron. Astrophys.; 33: No. 2, 177-186 (Jul 1974).

An attempt is made to obtain synthetic models of stellar populations which allow one to interpret the equivalent widths of absorption lines and the galactic flux observed in the central part of M 31 (inside 1.5 kpc). The galactic equivalent widths are compared with the equivalent widths of the same lines from a sample of stars which were classified as to their spectral type, luminosity, and metallic abundance. Stellar population are obtained from a numerical analysis which derives synthetic models. Several possible solutions are obtained; all these models are characterized by the presence of SMR stars, of a dwarf enriched main sequence, and of hot stars which implies continuous stellar formation. Furthermore it is seen that the stellar population changes significantly with distance: variation of the contribution from cool stars, large increase with distance of hot stars, and a drop followed by a little rise of SMR stars which leads to important variations of the M/L ratio across the central bulge. The stellar population grows hotter and bluer in the outer regions, and the deduced H–R diagrams show that the giant stars are more evolved in the nucleus than at 1.5 kpc. These variations involve a decrease with distance of the (U–B) and (B–V) indices. (auth)

30709 DYNAMICAL STABILITY OF THE NGC 1023 GROUP. Materne, J. (Hamburger Sternwarte, Hamburg). Astron. Astrophys.; 33: No. 3, 451-454(Jul 1974).

The dynamical stability of the NGC 1023 group, a classical group of galaxies, is reinvestigated with new observational data. The velocity errors are carefully taken into account. Contrary to former results the total energy of the group is negative; and the application of the virial theorem gives a mass which is in excellent agreement with the total luminous mass of the group. (auth)

30710 LUNAR OCCULTATIONS OF THE GALACTIC CENTER REGION IN H I, OH, AND H_2CO LINES. II. The Continuum and the +40km s^{-1} Feature. Sandqvist, A. (Stockholm Observatory). Astron. Astrophys.; 33: No. 3, 413-424(Jul 1974).

High-resolution contour maps of the 18 and 21 cm continuum from the Sgr A complex and of the OH and H I $N_L T^{-1}$ (N_L-projected density, T-excitation temperature) distributions in the +40km s^{-1} cloud seen towards Sgr A were obtained from the recent series

of lunar occultations of the galactic center region. The main peak of Sgr A has a half-width of between 3″ and 22″ (WDM)

30711 MULTICOLOR FAR INFRARED PHOTOMETRY OF GALACTIC H II REGIONS. Olthof, H. (Univ. of Groningen, Netherlands). Astron. Astrophys.; 33: No. 3, 471-472(Jul 1974).

Results are presented of far infrared photometric measurements of some galactic H II regions in the galactic plane between longitudes 350° and 40°. (auth)

30712 KINEMATIC INVESTIGATION OF GALACTIC STRUCTURE. Burton, W. B. (National Radio Astronomy Observatory, Charlottesville, VA); Bania, T. M. Astron. Astrophys.; 33: No. 3, 425-442(Jul 1974).

Several approaches to the investigation of the large-scale structure of the Galaxy which emphasize the kinematic aspects of the problems are discussed. (WDM)

30713 PHYSICAL CONDITIONS IN THE NUCLEI OF SPIRAL GALAXIES. II. Photometric and Spectroscopic Observations of the Nuclei of Southern Spiral Galaxies. Alloin, D.; Sareyan, J. P. (Observatoire de Meudon, France). Astron. Astrophys.; 33: No. 3, 331-336(Jul 1974).

New spectroscopic and photometric measurements are presented on the central regions of southern spiral galaxies. The photometric observations give the fluxes through narrow interference filters, four of which apply to the continuum, while three are specifically set up for the emission lines [O II] 3726–29 Å, Hβ 4861 Å, and [O III] 4959–5007 Å. A detailed study of these filters was made, in order to give an absolute and precise determination of flux. Eleven galactic nuclei were observed differentially with comparison stars, which were subsequently calibrated against Hayes standard stars. Spectroscopic results were added, in order to assess precisely the information content passed by each filter, and to obtain the profiles of the emission lines. As a by-product the computed UBV data for the comparison stars and also for the galactic nuclei are given: in this case, the UBV data is free from the emission line contribution and refers only to the continuous energy distribution. All results are uncorrected for reddening (by the object inself and by the Galaxy). (auth)

30714 PHYSICAL CONDITIONS IN NUCLEI OF SPIRAL GALAXIES. III. Analysis of Nuclei of Southern Spiral Galaxies. Alloin, D. (Observatoire de Meudon, France). Astron. Astrophys.; 33: No. 3, 337-342(Jul 1974). (In French).

In this study, use is made of the spectroscopic and photometric results presented in the preceding paper (Alloin and Sareyan, 1974), in order to determine the physical parameters of the emissive gas in the nuclei of some southern spiral galaxies. (WDM)

30715 LOW-FREQUENCY RADIO OBSERVATIONS OF THE STEPHAN'S QUINTET REGION. Kaftan-Kassim, M. A.; Sulentic, J. W. (State Univ. of New York, Albany). Astron. Astrophys.; 33: No. 3, 343-349(Jul 1974).

Continuum observations of the Stephan's Quintet region at 318, 430, and 606 MHz, made with the Arecibo telescope, are described. Flux densities and spectra of the sources detected as well as radio contour maps of the regions are given. (auth)

30716 HIGH RESOLUTION 6 CM OBSERVATIONS OF SEYFERT GALAXY NUCLEI. de Bruyn, A. G.; Willis, A. G. (Sterrewacht, Leiden). Astron. Astrophys.; 33: No. 3, 351-356 (Jul 1974).

Observations at 6 cm wavelength are presented of the Seyfert galaxies NGC 1068, 3227, 4151, and 7469 as well as the Seyfert-like galaxy NGC 2782. Except for NGC 3227 all sources are resolved. The maximum resolution attainable is about 2″. Each galaxy has a spectral index close to −0.80. The data and those of Bash (1968) suggest a two component model for NGC 1068. The compact component has a flat spectrum but probably has not varied significantly over the last 8 years. (auth)

30717 CLOSE ASSOCIATION OF PARAFORMALDEHYDE EMISSION WITH MAJOR IONIZATION FRONTS IN M 42. Elliott, K. H.; Meaburn, J. (Univ. of Manchester, Eng.). Astron. Astrophys.; 34: No. 3, 473-475(Sep 1974).

Major ionization fronts have been discovered around one of the strong peaks of the paraformaldehyde emission 120″ away from the Trapezium stars in the Orion Nebula. It is concluded that the molecules giving rise to this emission exist in neutral globules very close to these hot stars. (auth)

30718 USE OF LASERS TO STUDY THE PROPERTIES OF THE INTERPLANETARY MEDIUM. Kravtsov, N. V. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 578-579(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 633-634(1974).

The accuracy of measurements can be increased if the probing of space is conducted simultaneously with radio radiation and radiation in the optical range. In fact, recent measurements have shown the absence of appreciable dispersion in the propagation velocity of optical radiation in space. This makes it possible to use an optical beam as a reference signal when probing space with radiation in the radio and microwave ranges. (MHR)

30719 INTERSTELLAR MOLECULES. Winnewisser, G.; Mezger, P. G. (Max-Planck-Institut fuer Radioastronomie, Bonn (F. R. Germany)); Breuer, H. D. (Universitaet des Saarlandes, Saarbruecken (F. R. Germany). Inst. fuer Physikalische Chemie). Fortschr. Chem. Forsch.; No. 44, 1-81(1974).

A review is given of the physical conditions in interstellar space, observations of interstellar molecules and their interpretation, including relevant laboratory measurements, and experimental and theoretical investigations of the processes of formation and destruction relevant to interstellar molecules. This review covers primarily the interstellar matter proper and refers only briefly to observations of molecules in circumstellar shells or molecule formation in protostellar nebulae. (auth)

30720 DISTANT GALACTIC STRUCTURE IN PUPPIS: THE RUPRECHT 44 AGGREGATE. Moffat, A. F. J.; FitzGerald, M. P. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 34: No. 2, 291-296(Aug 1974).

Ruprecht 44 is a concentration of stars lying at the centre of a very young (~10^8 years), very distant (6.6 ± 0.6 kpc) aggregate, containing numerous OB stars. These stars are uniformly reddened by $E_{B-V} = 0.70 \pm 0.02$. Pre-main sequence evolution is evident for stars of $M_v \geq -1$. This object strengthens the suggestion of FitzGerald and Moffat (1974) that a prominent spiral feature lies at a distance of ~7 kpc in Puppis. (auth)

30721 INTERACTING GALAXY SYSTEM NGC 646. Danziger, I. J.; Schuster, H. E. (European Southern Observatory, Santiago). Astron. Astrophys.; 34: No. 2, 301-303(Aug 1974).

Direct photography and spectroscopy of the spiral system NGC 646 demonstrate that it can be easily interpreted as the result of a gravitational tidal interaction between two galaxies. (auth)

30722 RATE OF GROWTH OF DENSITY WAVES IN FLAT GALAXIES. Dekker, E. (Observatory, Leiden). Astron. Astrophys.; 34: No. 2, 255-261(Aug 1974).

An expression for the rate of growth (or decay) of density waves in flat galaxies is derived. Its physical meaning in terms of angular momentum (or energy) exchange between "resonant" stars and the wave is explained. It is shown that growing waves can be expected to occur in a limited range of frequencies (or pattern speeds). Any waves outside this range are expected to be damped. (auth)

30723 RADIO CONTINUUM SURVEY OF M 31 AT 2695 MHz. I. Observations; Comparison of Radio Continuum Data. Berkhuijsen, E. M.; Wielebinski, R. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 34: No. 2, 173-179 (Aug 1974).

Observations have been made of the Andromeda Nebula, M 31, at 2695 MHz, half-power beamwidth 4.8′, with the 100-m radio telescope of the Max-Planck-Institut für Radioastronomie. The map covers an area of 3.9° × 1.1°, aligned with the nebula. Several spiral arms are clearly seen; their radio emission has a non-thermal spectrum. At 2695 MHz about 50% of the radiation is thermal. The map has been examined at the positions of the 5 C 3 sources and, where possible, spectra have been computed. Four new sources have been found above the 5 σ-level. An upper limit of 0.034 fu is found for M 32. (auth)

30724 AGE OF THE GALAXY BY NUCLEAR YIELD RATIOS. Beck, F.; Hilf, E.; Maier, K. (Technische Hochschule, Darmstadt, Ger.). Acta Phys. Austr.; 38: No. 2, 201-205(1973).

Calculation of the time interval of galactic nucleosynthesis from its beginning to the formation of the solar system ("age of the galaxy" τ_1) by primary nuclear yield ratios based on recent mass formulas result to $\tau_1 \simeq 10 \cdot 10^9$a. Recalculating this with more recent decay data including spontaneous fission one obtains $\tau_1 \gtrsim 70 \cdot 10^9$a, in much better agreement with other astronomical evolution data. The influence of the termination of the γ-process path by neutron-induced fission may be nevertheless the decisive property and will be taken into account in further calculations. (auth)

30725 RADIO ASTRONOMICAL DETERMINATION OF GROUND STATE TRANSITION FREQUENCIES OF CH. Rydbeck, O. E. H.; Elldér, J.; Irvine, W. M.; Sume, A.; Hjalmarson, A. (Onsala Space Observatory, Sweden). Astron. Astrophys.; 34: No. 3, 479-482(Sep 1974).

From a comparison of the spectra of CH and other molecules towards Cas A and dark clouds, the rest frequencies of the three allowed transitions of the $^2\Pi_{\frac{1}{2}}$, $J = \frac{1}{2}$, ground state Λ-doublet of CH were determined to be $\nu_{01} = 3263.794 \pm 0.003$, $\nu_{11} = 3335.481 \pm 0.002$, and $\nu_{10} = 3349.193 \pm 0.003$ MHz. These frequencies cannot

be checked by the sum rule, $\nu_{11} + \nu_{00} = \nu_{10} + \nu_{01}$, since the ν_{00}-transition is forbidden in this particular case. The relative errors in these frequencies are about twice as small as those obtained earlier by radio astronomical methods for the two main lines of ground state OH. Further refinements in the determination of the CH frequencies are desirable, since these transitions have not yet been directly measured in the laboratory. (auth)

30726 EXCESS REDSHIFTS IN GROUPS OF GALAXIES. Burke, J. A.; Hartwick, F. D. A. (Univ., Victoria, British Columbia). Astron. Astrophys.; 34: No. 3, 445-447(Sep 1974).

A plot of differential velocities and distances of members of groups of galaxies with respect to the brightest member of each group shows a correlation between these two quantities. This suggests that some groups are actually considerably spread in radial distance. Such a spread allows the possibility of a number of well known selection effects which could cause an apparent average excess redshift of group members with respect to the brightest galaxy. (auth)

30727 INTERACTION OF METAGALACTIC x-uv RADIATION WITH GALACTIC HYDROGEN. Hill, J. K. Astron. Astrophys.; 34: No. 3, 431-436(Sep 1974).

Calculations show that the existence of a metagalactic x-uv flux of the intensity required to explain the high-latitude soft x-ray observations, plus a reasonable extrapolation toward lower energies, is consistent with the existence of neutral hydrogen in galaxies. Shielding by H II slabs can be effective both in the solar neighborhood and in the peripheries of galaxies out to a radius of 30 to 40 kpc. At earlier cosmological epochs shielding is less efficient. The soft x-ray spectrum as observed by Yentis et al. is difficult to reconcile with a purely extragalactic origin for the flux. A local source of ionization also may be necessary to explain the pulsar dispersion data. (auth)

30728 EXTREME-ULTRAVIOLET SEARCH OF THE NORTH GALACTIC POLAR REGION. Henry, P.; Cruddace, R.; Paresce, F.; Bowyer, S.; Lampton, M. (Univ. of California, Berkeley). Astrophys. J.; 195: No. 1, 107-110(1 Jan 1975).

An area of approximately 1350 square degrees around the north galactic pole was searched for sources radiating at extreme-ultraviolet wavelengths. Discrete sources within this region were not detected at fluxes above the level set by the instrument sensitivity, 4.3×10^{-8} ergs cm^{-2} s^{-1}, in the 135 to 475 Å band. (auth)

30729 NONDETECTION OF INTERSTELLAR ISOTHIOCYANIC ACID (HNCS). Andrew, B. H.; Avery, L. W. (National Research Council of Canada, Ottawa). Astron. Astrophys.; 35: No. 2, 295-296(Oct 1974).

An unsuccessful search was made for radio emission at 23.458 GHz from the $2_{02}-1_{01}$ transition of isothiocyanic acid. The 3σ upper limits to the brightness temperatures were 0.13 K, 0.16 K, and 0.22 K in Sgr. B2, W 51, and Orion A, respectively. (auth)

30730 OH AND H I OBSERVATIONS OF THE PERSEUS OB2 DUST CLOUD. Sancisi, R. (Univ. of Groningen, Netherlands); Goss, W. M.; Anderson, C.; Johansson, L. E. B.; Winnberg, A. Astron. Astrophys.; 35: No. 3, 445-458(Oct 1974).

The large dust cloud in the region of the association Per OB2 was mapped in the 1667-MHz line of OH and in the 21-cm emission line of H I. The distributions of peak antenna temperature and column density of OH correlated with interstellar extinction very well; it was found that $N_{OH}/\Delta m = 0.9 \times 10^{14}$ mol cm^{-2} mag^{-1}. For the H I emission a simple correlation was not present; the average ratio of N_{OH} to N_H was 2×10^{-7}. At most positions in the cloud low optical depth and LTE conditions appeared to predominate in OH. However, in a few positions the 1665 MHz line was anomalously weak compared to the 1667 MHz line. The velocity fields of OH and of H I were very similar. At seven positions in the cloud 9-cm CH data were available; the velocities of CH were in good agreement with those of OH. It was concluded that H I, dust, OH, CH, and other molecules are physically associated in one cloud. Probably this is a part of an expanding shell of interstellar gas and dust in the region of the association Per OB2. The kinematics of the dust cloud and of the stellar association seem to be related. (auth)

30731 GASEOUS STRUCTURE IN THE GALACTIC CENTER REGION. Kaifu, N.; Iguchi, T.; Kato, T. (Tokyo Univ. (Japan). Faculty of Science). Publ. Astron. Soc. Jap.; 26: No. 1, 117-128 (Mar 1974).

The existence of an almost complete ring of neutral hydrogen similar to the 270-pc expanding ring determined from OH and H_2CO data is indicated. The total mass of the expanding ring is estimated to be 1×10^7 $M_\odot$ and the kinetic energy of expansion to be 4×10^{54} erg. The expanding ring is seen to be inclined several degrees of arc to the galactic plane. The interpretation based on the shock wave model of the expanding ring is briefly discussed. Discussions of the infrared and nonthermal radio emissions suggest that these emissions may be radiated from the dense region of the expanding ring. (auth)

30732 SEARCH FOR ISOLATED MICROWAVE PULSES FROM THE PERSEUS CLUSTER OF GALAXIES. Delaney, T. (University Coll., Dublin); Baird, G. A.; Smith, H.; Jelley, J. V.; Fruin, J. H.; Meikle, W. P. S.; Drever, R. W. P.; Morigi, G.; Palumbo, G. G. C.; Partridge, R. B. Astron. Astrophys.; 36: No. 1, 83-85 (Nov 1974).

A search for prompt microwave emissions from supernovae in the central region of the Perseus cluster of galaxies, using a coincidence technique involving five tracking radiometers located at widely spaced sites is described. No coincidences were found between January and December, 1973, and no supernovae were reported during this period from the optical surveys, in that region of sky. (auth)

30733 RADIATION COLOR TEMPERATURE AND GLOBULE SHAPES. Dyson, J. E. (Univ. of Manchester, Eng.). Astron. Astrophys.; 36: No. 1, 79-81(Nov 1974).

The jump conditions across strong D type fronts depend on the color temperature of the uv radiation incident at the I-front. These conditions are calculated using an empirical relationship due to Briscoe (1972). Neutral globules placed in a radiation field isotropic in terms of photon number but axisymmetric in terms of photon energy tend to flatten towards maxima in the photon energy distribution. (auth)

30734 EFFECTS OF SUPERNOVAE ON THE EARLY EVOLUTION OF GALAXIES. Larson, R. B. (Yale Univ., New Haven). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 229-245(Nov 1974).

During the early evolution of an elliptical galaxy, some of the residual interstellar gas is heated to high temperatures by supernova explosions and is driven out of the galaxy in a galactic wind. The energy supplied per supernova is typically reduced about an order of magnitude by radiative cooling of supernova remnants, but the remaining energy is still sufficient to cause significant gas loss, particularly for small galaxies. In galaxies of smaller mass, gas loss begins earlier and carries away a larger fraction of the initial mass, owing to the lower escape velocity. Model collapse calculations show that the effect of early gas loss is to cause galaxies of smaller mass to have less condensed nuclei, smaller average metal abundances, and smaller metal abundance gradients, in qualitative agreement with the observations. (auth)

30735 INTERSTELLAR MEDIUM IN THE DIRECTION OF THE GUM NEBULA. Burton, W. M.; Evans, R. G.; Griffin, W. G. (Science Research Council, Abingdon, Eng.). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 307-321(Nov 1974).

High-resolution ($d\lambda \simeq 0.3$ Å) ultraviolet spectra of γ ^{2}Vel and ζ Pup, obtained from a star-stabilized Skylark rocket flight, have been used to study the interstellar gas in the direction of the Gum Nebula. The observations confirm the existence of a large H II region in the line of sight and also give evidence for the existence of small localized regions of high gas density ($\sim 10^4$ cm^{-3}). All of the elements observed in the interstellar gas are underabundant relative to hydrogen. (auth)

30736 DETECTION OF IONIZED NEON IN THE GALACTIC CENTRE. Aitken, D. K.; Jones, B.; Penman, J. M. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 35P-38P(Nov 1974).

Observations are reported of the 12.8 μ Ne II fine structure line from the galactic centre source Sgr A(West). These observations confirm the thermal nature of the source and indicate that in this region the neon abundance is approximately normal, and the gas to dust ratio is very large. (auth)

30737 BROADBAND OPTICAL AND INFRARED OBSERVATIONS OF SEYFERT GALAXIES. Penston, M. V.; Penston, M. J.; Selmes, R. A.; Becklin, E. E.; Neugebauer, G. (Hale Observatories, Pasadena, CA). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 357-393(Nov 1974).

Broadband observations between 0.3 and 3.4 μ are reported for 11 bright Seyfert galaxies. The ultraviolet and two micron fluxes of NGC 4151 have both increased by ~0.3 mag between 1970 and 1971. 3C 120 was constant to within about ±0.1 mag in the infrared during a period when it varied in the optical by ~0.8 mag. Comparison with published data suggests NGC 4051 is an optical variable. The spatial distribution of the emitted flux shortward of 2.2μ suggests that the emission from Seyfert galaxies can be decomposed into a nuclear source showing ultraviolet and infrared excesses and an extended source with normal starlike colors. The U-B and B-V colors fall on the two-color diagram in positions consistent with a mixture of light from sources with galaxy-like and quasar-like colors and can be used to derive the ratio of the light from the nuclear source to that from the surrounding

galaxy. This ratio is used to separate the contributions of nuclear source and galaxy in the infrared. The infrared spectrum of the nuclear source in NGC 1068 is steeper than that in the other Seyfert galaxies and more closely resembles that of non-Seyfert infrared galaxies such as M82 and NGC 253 rather than that of quasars. A wide range exists in the proportion of blue light contributed by the nuclear sources but the $(B-[2.2\mu])_0$ colors of the combined emission range only by ±0.3 mag implying large differences exist in the $(B-[2.2\mu])_0$ of the nuclear source alone, in contrast to the homogeneity of the purely optical colors. (auth)

30738 VARIABLE STARS IN THE LARGE MAGELLANIC CLOUD. III. Lindsay, E. M. (Armagh Observatory, Northern Ireland). Mon. Notic. Roy. Astron. Soc.; 169: No. 2, 343-352 (Nov 1974).

Data are given for 27 new or suspected variables in the Large Magellanic Cloud. (auth)

30739 GALACTIC GAS-TO-DUST RATIO FROM OBSERVATIONS OF EIGHTY-ONE GLOBULAR CLUSTERS. Knapp, G. R.; Kerr, F. J. (Univ. of Maryland, College Park). Astron. Astrophys.; 35: No. 3, 361-379(Oct 1974).

21-Cm line profiles from hydrogen were observed in the directions of eighty-one galactic globular clusters, with the purpose of measuring the gas-to-dust ratio in the Galaxy. The dust column density is given by the reddening of the cluster. Advantage was taken of the fact that the gas and dust column densities are measured using similar sampling geometries. The results show that the H I column density and the reddening are very closely correlated, and that this correlation is independent of galactic latitude. (WDM)

30740 NGC 7331 GROUP, A STABLE GROUP OF GALAXIES PROJECTED ON STEPHAN'S QUARTET. Materne, J.; Tammann, G. A. (Observatory, Hamburg). Astron. Astrophys.; 35: No. 3, 441-444(Oct 1974).

The galaxies NGC 7331, NGC 7320, DDO 213, and an anonymous galaxy observed by Shostak form a physical group—the NGC 7331 group—which is apparently stable against dynamical disruption. This strengthens the view that NGC 7320, the one member of Stephan's "Quintet" with a discordant redshift, is actually a foreground galaxy lying at the same distance (20 Mpc) as NGC 7331. This conclusion is further supported by Limber and Mathews (1960) who have shown that the ramaining four high-redshift galaxies, i.e., "Stephan's quartet", form also a dynamically stable configuration. (auth)

30741 PECULIAR GALAXY NGC 3077. Barbieri, C.; Bertola, F.; di Tullio, G. (Univ., Padua). Astron. Astrophys.; 35: No. 3, 463-466(Oct 1974).

The irregular galaxy NGC 3077, a member of the M 81 group, was investigated by means of direct photographs and spectra. A system of filaments was detected in H_α light while the blue structure was dominated by wide absorption regions and by several knots. Resolution in the outer regions was achieved by a deep exposure plate. No rotation was detected over a region of about 40" and there was some evidence of small local velocity gradients. The problem of star formation and of the Irr II galaxies is briefly discussed. (auth)

30742 MORPHOLOGY OF THE CENTRAL REGION OF THE ORION NEBULA IN THE NEAR INFRARED. Andrillat, Y. (Observatoire de Haute Provence, Forcalquier, France); Duchesne, M. Astron. Astrophys.; 35: No. 3, 467-472(Oct 1974). (In French).

Several photographs were obtained of the central region of the Orion nebula with the electronic camera in the region λ 11000 to 7500 Å, using interferential filters isolating the following emissions [A III] λ 7751 Å, [S III] λ 9069 Å, [S II] λ 10284, 10318, 10336 Å and the continuum, and He I λ 10830 Å. Except for He I λ 10830 Å, there was no striking differences in structure between these pictures. The intensity distribution of He I λ 10830 Å was found to be consistent with the results deduced from spectrometric and interferometric observations: the dust particles are mixed with the gas and absorb the λ 10830 Å photons. Finally, the picture corresponding to [S II] showed numerous stars not visible on the other photographs. (auth)

30743 SOUND SPEED AT RECOMBINATION TIME AND GALAXY FORMATION. Bonometto, S. A.; Danese, L.; Lucchin, F. (Univ., Padua). Astron. Astrophys.; 35: No. 2, 267-270 (Oct 1974).

A tentative computation of the velocity of sound during hydrogen recombination is presented, and we try to determine the value of z at which the primeval vorticity becomes supersonic. The velocity of sound is found to depend on wave-length and to have higher values on larger scales; therefore, it is possible that the formation of shock waves involving masses large enough to give rise directly to galaxies would occur only at a late z. The high rate of dissipation would then make it hard for vorticity to survive so long unless a turbulence feeding mechanism can be devised. (auth)

30744 DIFFERENTIAL ABUNDANCE ANALYSIS OF α TAU RELATIVE TO α BOO. van Paradijs, J.; Meurs, E. J. A. (Univ. of Amsterdam). Astron. Astrophys.; 35: No. 2, 225-231(Oct 1974).

The line spectrum of α Tau (K 5 III) was analyzed relative to that of α Boo (K 2 IIIp). The observations are based upon high dispersion spectrograms (1.6 Å/mm), obtained with the 100 inch telescope at Mt. Wilson Observatory. The data have been interpreted with model atmospheres, derived from the temperature-optical depth relations of Carbon and Gingerich (1969). The effective temperature difference between α Tau and α Boo was obtained from several continuum data, the Fe I line spectrum and the surface brightness. It is found that $T_{eff}(\alpha\ Tau) = 3970 \pm 70K$, $T_{eff}(\alpha\ Boo) = 4350 \pm 50$ K and $\Delta\theta_{eff} = 0.11 \pm 0.01$. The surface gravities derived from the ionization equilibria of five elements are $\log g_{\alpha\ Tau} = 1.3 \pm 0.35$ and $\log g_{\alpha\ Boo} = 1.95 \pm 0.25$. The abundance results confirm the previously found metal deficiency of α Boo (a factor of three relative to the sun); α Tau has solar abundances for the majority of the elements. (auth)

30745 STRUCTURE OF INTERSTELLAR MATTER. III. Density Wave Kinematics and Spiral Structure in Neutral Hydrogen Gas. Rohlfs, K. (Max-Planck-Institut fuer Radioastronomic, Bonn). Astron. Astrophys.; 35: No. 2, 177-190(Oct 1974).

An operational definition for interstellar hydrogen clouds is given which permits a separation of the 21-cm cloud radiation from that of the intercloud medium—called stratum here—to be made even for galactic plane regions. The cloud radiation includes the emission from the fluctuating part of the interstellar gas density field and variations of the line profiles produced by small scale velocity field fluctuations, while the stratum radiation contains the large scale density variations and all large scale velocity field effects. The velocity field therefore can be determined by investigating stratum line profiles. An explicit discussion of such an analysis is given. As an example, this method has been applied to the galactic plane region in Cassiopeia, and velocity-distance relations are determined. They show quite clearly density wave like streaming motions in the gas. The large difference in the distance to the Perseus arm by optical and radioastronomical means has been reduced to a negligible amount and the pitch angle of this arm according to both data sets is the same. (auth)

30746 ESTIMATE OF THE INTERGALACTIC ABSORPTION IN THE JAGELLONIAN FIELD. Tarraro, I. (Marie Curie Univ., Lublin). Postepy Astron.; 22: No. 4, 345-348(Dec 1974). (In Polish).

Based on data regarding the visibility of galaxies in the "Jagellonian Field Catalogue" the lower limit of the coefficient of the selective intergalactic absorption was estimated. It amounts to $0.0020^m \pm 0.0004^m$ per Mpc in the blue–yellow color index and to $0.0005^m \pm 0.0003^m$ in the yellow–red. (auth)

30747 CHEMICAL EVOLUTION OF GALAXIES. Basinska-Grzesik, E. (Inst. of Astronomy, Warsaw). Postepy Astron.; 22: No. 4, 313-327(Dec 1974). (In Polish).

The problems connected with the chemical composition of matter and its evolution in galaxies, especially in our own Galaxy, are briefly described. (auth)

Cosmology

Refer also to abstract 31027.

30748 (JINR-P2-8585) ORIGIN OF GALAXIES ROTATION IN AMBARZUMIAN'S COSMOGONY. Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The origin of angular momentum of galaxies and of their clusters is attributed to conservation of the spin of supermassive hadrons, in decays of which the galaxies are formed according to the ideas of Ambarzumian's superdense cosmogony. (auth)

30749 (KFKI-74-84) ROBERTSON–WALKER SOLUTIONS FOR VARIOUS TYPES OF ENERGY-MOMENTUM TENSOR. Lukacs, B. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Dec 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

Robertson–Walker metrics are extremely important in general relativity as Universe solutions or spherical symmetric homogenous internal solutions. This paper contains a number of Robertson–Walker type solutions for certain types of energy-momentum tensor, namely for noncharged massless scalar meson fields,

viscous fluids, Hookean elastic and visco-elastic "Kelvin–Voigt" media. (auth)

30750 (KFKI-74-87) ALL STATIONARY, RIGIDLY ROTATING INCOHERENT FLUID METRICS WITH GEODESIC AND/OR SHEARFREE EIGENRAYS. Lukacs, B. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Dec 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

This paper deals with solutions of the Einstein-equations of general relativity which contain stationary, rigidly rotating incoherent fluid. By the help of the three dimensional spin coefficient method the general solutions were found for the cases when the gravitational field has eigenrays which are: a. geodesic and shearfree, b. geodesic and shearing, and c. nongeodesic and "shearfree" $\sigma = 0$. There are certain solutions which are flat in infinity, but have no Schwarzschild-like behavior at large spatial distances. Thus their physical interpretation is doubtful. (auth)

30751 (NP-20306) TERRELL EFFECT. Cervantes, J. C. L. (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Fisica y Matematicas). 1970. 45p. (In Spanish). Dep. NTIS (US Sales Only) $5.25.

Thesis.

The Terrell effect consists in the proof that the Lorentz contraction is neither visible nor photographable. The consequences of this effect are analyzed mathematically. Stereoscopic vision of a moving object and of a sphere at rest is considered in some detail. (JSR)

30752 FREE GRAVITATIONAL FIELDS AND THE DEVELOPMENT OF SMALL PERTURBATIONS IN AN ISOTROPIC COSMOLOGICAL MODEL. Chernin, A.D. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR). Sov. Astron.–AJ 18: No. 4, 441-443 (Jan 1975).

The contribution of free gravitational fields to cosmogonical processes in an isotropic expanding universe is analyzed. An ensemble of gravitational waves distributed with statistical isotropy will impede the growth of instabilities on scales substantially larger than the characteristic wavelength λ_*. On scales smaller than λ_*, free gravitational fields can stimulate the development of perturbations in the density and velocity of matter. (auth)

30753 COMPTONIZATION, CHARACTERISTIC RADIATION SPECTRA, AND THERMAL BALANCE OF LOW-DENSITY PLASMA. Illarionov, A.F.; Syunyaev, R.A. (Institute for Space Research, Academy of Sciences of the USSR, Moscow). Sov. Astron.–AJ 18: No. 4, 413-419 (Jan 1975).

The role of Compton scattering in the formation and evolution of radiation spectra in low-density plasma is investigated. A problem of importance for cosmology is considered: distortions in the blackbody primordial-radiation spectrum through interaction with electrons whose temperature differs from the radiation temperature. The evolution of a blackbody spectrum formed in a homogeneous low-density plasma by the joint operation of free-free processes (supplying the photons) and Compton scattering (redistributing these photons over the spectrum) will proceed along a series of Bose-Einstein spectra whose chemical potential decreases with time. In this situation a blackbody spectrum will be reached far more rapidly (by a factor of 10–100) than if only free-free processes were operative, and there will be a corresponding major increase in the plasma energy-loss rate. The results are of interest for theories of a "hot" universe and compact x-ray sources. (auth)

30754 TESTS FOR GENERAL RELATIVITY. Urusovskii, I.A. (Acoustics Institute, Academy of Sciences of the USSR). Sov. Astron.–AJ 18: No. 4, 488-491 (Jan 1975).

General-relativity corrections to the trajectory shape and orbital velocity of planets are derived. Doppler measurements of the orbital velocity would provide a verification of general relativity theory independent of previous tests. With the accuracy that can now be attained in determining the orbital elements of planets, the modified Kepler law would enable the ratio of the sun's gravitational radius to the velocity of light to be evaluated with an error of $3 \cdot 10^{-4}$. A discussion is given of how this law can be applied for an independent test of general relativity. Intergrals of motion are given for a spherically symmetric gravitational field; equations deduced from them afford an experimental check on general-relativity effects. (auth)

30755 UPPER LIMIT ON PHOTON–PHOTON INTERACTION FROM PHYSICAL COSMOLOGY. Puget, J. L.; Schatzman, E. (Observatoire, Meudon, France). Astron. Astrophys.; 32: No. 4, 477-478(Jun 1974).

It is shown that if the microwave background has been emitted as blackbody radiation, enough is known about its spectrum to put upper limits on photon–photon interaction relevant to the problem of the origin of redshifts. (auth)

30756 EFFECT OF LUMPY MATTER DISTRIBUTION ON THE GROWTH OF IRREGULARITIES IN AN EXPANDING UNIVERSE. Peebles, P. J. E. (Univ. of California, Berkeley). Astron. Astrophys.; 32: No. 4, 391-397(Jun 1974).

Given that matter is distributed in a lumpy fashion, in galaxies and clusters of galaxies in the present Universe, perhaps in small lumps at an early epoch, one would suppose that the grainy distribution has some effect on the growth of irregularities. It has been suggested that there is a substantial minimum rate of growth of structure once grains form. However, it is shown here that the effect has been overestimated, so that it seems questionable whether it could have played an interesting role in the origin of galaxies. (auth)

30757 EINSTEIN'S PRINCIPLE OF EQUIVALENCE USED FOR AN ALTERNATIVE RELATIVISTIC COSMOLOGY CONSIDERING THE SYSTEM OF GALAXIES AS LIMITED AND NOT AS THE UNIVERSE. Klein, O. Kgl. Dan. Viedensk. Selsk., Mat.-Fys. Medd.; 39: No. 2, 3-18(1974). (In French).

The principle of equivalence, as the basis of Einstein's theory of gravitation is discussed in detail and illustrated by the clock paradox. It is then shown that Einstein's arguments for his cosmology are incompatible with the principle of equivalence, and that the Schwarzschild singularity, implying a density limit, makes the formation of a relativistic cosmology impossible. An alternative, which the author put forward sometime ago, is presented. In conclusion a model for the "fireball" background radiation, without the fireball, is given. (DE)

30758 MATTER-ANTIMATTER SEPARATION: THE TYPICAL SIZE OF THE EMULSION. Aly, J. J. (CEN, Saclay, France). Astron. Astrophys.; 35: No. 2, 311-313(Oct 1974).

An estimate is given of the characteristic scale of the separation of matter and antimatter in the first stage of the symmetric cosmology proposed by Omnès. It is found that this scale is determined by a hydrodynamical process due to the existence of a surface tension, rather than by a diffusion process. Its value at the end of the separation period is of the order of 7.10^{-4} cm (auth)

30759 AMOUNT OF MATTER IN A MATTER–ANTIMATTER MODEL OF THE UNIVERSE. Aly, J. J.; Caser, S.; Omnes, R.; Puget, J. L.; Valladas, G. (Univ., Paris). Astron. Astrophys.; 35: No. 2, 271-281(Oct 1974).

One reconsiders the calculation of the amount of matter in a matter–antimatter symmetric universe, assuming some symmetry breaking due to a phase separation of matter from antimatter at high temperatures. The original calculation by Omnès has been subjected to two main criticisms: Zeldovich has called attention to the importance of initial correlations while Steigman has pointed out the determinant role of neutron diffusion in annihilation. These two effects, and several others, are included here and further analyzed. It turns out that the final amount of matter that is found is lower than observed in a perfectly quiet Universe, as noticed by Zeldovich. However it is also found that any small amount of initial turbulence (with velocities larger than 4×10^2 cm/s at a time 10^{-5} s), is enough to break the initial correlations and gives exactly the observed amount of matter. Some past conclusions as to the absence of helium synthesis in the model are also withdrawn. (auth)

Planetary Phenomena

Refer also to abstracts 30440 and 30754.

30760 (LA-UR-74-1202) WIND FLOW OVER SIMULATED STRUCTURES FOR MARTIAN AND TERRESTRIAL ATMOSPHERES. Jones, E. M.; Kirby, T. B. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 4p. (CONF-741110-1). Dep. NTIS $4.00.

From 6th conference on aerospace and aeronautical meteorology; El Paso, Texas, USA (12 Nov 1974).

A calculation of a 50 m/s wind flowing past a linear Martian feature with the same cross section as a typical high-rimmed, flat-floored Martian crater is presented. The status of attempts to reproduce wind flow observed in Owens Valley, California during the 1951-1952 Sierra wave project is discussed. (WDM)

30761 MODELS OF JUPITER AND SATURN. I. REFERENCE DATA. Zharkov, V.N.; Makalkin, A.B.; Trubitsyn, V.P. (Institute of Earth Physics, Academy of Sciences of the USSR). Sov. Astron.–AJ 18: No. 4, 492-498 (Jan 1975).

The observational data and boundary conditions for adiabatic models of Jupiter and Saturn are discussed. The cosmochemical elements and compounds are classified by groups. Equations of state for hydrogen and for groups of substances are analyzed. The method of calculation of the models is briefly presented. (auth)

30762 THE IONOSPHERE AND ATMOSPHERE OF IO. Whitten, R.C.; Reynolds, R.T. (Theoretical Studies Branch, NASA-Ames Research Center, Moffett Field, California 94035); Michelson, P.F. Geophys. Res. Lett. 2: No. 2, 49-51 (Feb 1975).

In order to explain the ionosphere of Io as observed by Pioneer 10, we propose a tenuous atmosphere of neon, which is ionized by solar radiation. Predicted plasma number densities and temperatures are presented and discussed. (auth)

30763 NON-LTE RADIATIVE TRANSFER IN THE VIBRATION-ROTATION BANDS OF LINEAR MOLECULES. Shved, G.M. (Department of Atmospheric Physics, Leningrad University). Sov. Astron.—AJ 18: No. 4, 499-504 (Jan 1975).

An approximate equation of transfer is formulated and equations are derived for the source function applicable the the vibration-rotation bands of linear molecules, in the case where local thermodynamic equilibrium over the vibrational degrees of freedom is violated. An analysis is carried out for a plane-parallel semiinfinite atmosphere, with stimulated emission neglected, under the following basic approximations: 1) the lines of the band do not overlap; 2) the Boltzmann distribution is valid for the rotational states; 3) the combined contribution of each branch of the band may formally be taken into account by integrating over the rotational quantum number j. The applicability of the equations to the 4.3— and 15—μ CO_2 bands and the 4.7—μ CO band in the atmospheres of the earth, Venus, and Mars is discussed. The equations may also prove useful for the theory of transfer in the bands of linear molecules in the atmospheres of cool stars. (auth)

30764 THE JOVIAN IONOSPHERE. Prasad, S.S.; Tan, A. (Department of Physics and Astronomy, University of Florida Gainesville, Florida 32611). Geophys. Res. Lett. 1: No. 8, 337-340 (Dec 1974).

Models for the Jovian ionosphere which incorporate the role of hydrocarbons in the production and loss of ionization, are presented. A new feature is the possible existence of a second peak in the electron density distribution. On comparing our model with the results of the Pioneer—10 measurements of the Jovian ionospheric electron density—distribution, we find several important differences. Plausible explanations for these differences are also discussed. (auth)

30765 PERIODIC ESCAPE OF RELATIVISTIC ELECTRONS FROM THE JOVIAN MAGNETOSPHERE. Hill, T.W.; Carbary, J.F.; Dessler, A.J. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). Geophys. Res. Lett. 1: No. 8, 333-336 (Dec 1974).

We adopt a model in which the Jovian magnetospheric tail is forced open by plasma that is accelerated out of the ionosphere by the centrifugal force of corotation. Any longitudinal asymmetry that exists in the ionospheric plasma source and/or the planetary magnetic field will cause a diurnal variation in the radial extent of the trapping region for energetic electrons. This diurnal variation in the extent of the particle trapping region can result in a time—dependent loss of relativistic electrons from the Jovian magnetosphere, modulated at the planetary rotation period. The diurnal trapping process may be relevant to the observation of electron pulses in interplanetary space during the Pioneer 10 approach to Jupiter. (auth)

30766 THE PHOTOIONIZATION AND DISSOCIATIVE PHOTOIONIZATION OF H_2, HD, AND D_2. Ford, A.L.; Docken, K.K.; Dalgarno, A. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. 195: No. 3, 819-824 (1 Feb 1975).

The cross sections for photoionization of H_2 to the bound and continuum vibrational levels of the $1s\sigma_g$ state of H_2+ have been calculated in the range 804—425 Å ionizing radiation. The dipole <ion matrix elements have been computed as a function of ejected electron energy and internuclear distance using a simple Coulomb approximation to the final—state scattering wave function. The relative population of the v levels of H_2^+ at 584 Å, the ratio of production of H^+ to H_2^+ as a function of photon energy, and the total photoionization cross section are in good agreement with experimental measurements. (auth)

30767 EFFECT OF SOUND WAVES, ALFVEN WAVES, AND HEAT FLOW ON INTERPLANETARY SHOCK WAVES. McKenzie, J. F. (European Space Research Inst. Frascati, Italy); Bornatici, M. J. Geophys. Res.; 79: No. 31, 4589-4594(1 Nov 1974).

The effects of sound waves, Alfvén waves, and "additional" heat flow on shock waves are analyzed. For the special cases in which the waves make their greatest impact on the Rankine—Hugoniot relations it is found that (1) Alfvén waves diminish the shock compression and (2) sound waves either enhance or diminish the compression ratio according to whether the incident wave vector is parallel or antiparallel to the direction of flow through the shock. An additional heat flux may either enhance or diminish the compression ratio depending upon whether the heat flux behind the shock is greater or less than that ahead of it. The implications of these results for interplanetary shocks are discussed. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 29228 and 29320.

30768 (AD-780970) ATOMIC COLLISIONS AND PLASMA PHYSICS. Final Report, 16 December 1969–15 December 1972. Biondi, M. A. (Pittsburgh Univ., Pa. (USA). Dept. of Physics). 24 May 1974. 6p. (AROD-3187.16-P). NTIS $3.00.

Research results concerning atmospheric ion reactions are briefly summarized. Measurements of the coefficients of recombination of electrons with positive ions of the $H_3O(+) \cdot (H_2O)N$ series were carried out. Clustering of NO(+) ions to N_2 and to H_2O was studied to clarify the cluster-switching sequence responsible for D-region production of $H_3O(+) \cdot (H_2O)N$ series ions. Reaction rates of O(+) with N_2 and O_2 to form NO(+) and $O_2(+)$ at high ion temperatures F-region conditions were determined. Ionization and electron heating by metastable atoms were studied in very pure helium afterglows. (GRA)

30769 (ONERA-NT-202) LABORATORY SIMULATION OF THE IONOSPHERIC PLASMA. Charpenel, M.; Pigache, D. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92–Chatillon (France)). 1972. 22p. (In French). Dep. NTIS (US Sales Only) $4.25.

An exact simulation of satellite motion in the ionospheric plasma has been obtained in a large vacuum chamber by means of a synthesized collisionless plasma stream produced by a low energy and high current density ion source. The plasma density, the beam velocity and the electron temperature can be varied between 10^4 and $10^6/cm^3$, 7 and 30km/sec, 500 and 2000K respectively. An approximate simulation of a sounding rocket motion in the D and E layers has been obtained with the same plasma source by increasing the pressure in the vacuum chamber. The ion beam velocity is then reduced to zero but the variation ranges of plasma density and electron temperature are unchanged. (FR)

30770 (TRITA-EPP-74-18) VERTICAL PROPAGATION OF TIME-DEPENDENT ELECTRIC FIELDS IN THE ATMOSPHERE AND IONOSPHERE. Bostroem, R.; Fahleson, U. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Aug 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

Basic methods are investigated for calculation of the vertical propagation of time-dependent electric disturbances in the atmosphere. It is shown how problems involving time-dependent fields can be solved taking into account displacement currents and induction (nonpotential) fields as well as the anisotropy and frequency dependence of the complex ionospheric conductivity. Results referring to fields in the form of sinusoidal traveling or standing waves are given and it is shown that fields of a horizontal scale of about 100 km or more penetrate from above to balloon altitudes (30 to 40 km) with little damping provided the temporal variation is slower than 1 second. Fields of a horizontal scale of 1 km penetrate from above only to the E layer with little damping for time-independent fields and the damping becomes substantial for time-dependent fields even for periods as long as 1 hour. The field response upon a transient change in the source is also studied. The often quoted result that the temporal variation of the field at each point is governed by the local relaxation time is shown to have only a limited applicability. (auth)

30771 DIURNAL FLOW PATTERN OF FIELD-ALIGNED CURRENTS. Zmuda, A. J.; Armstrong, J. C. (Johns Hopkins Univ., Silver Spring, MD). J. Geophys. Res.; 79: No. 31, 4611-4619(1 Nov 1974).

Gross characteristics of the vector magnetic field perturbations detected by the Triad satellite at 800-km altitude in the auroral oval are analyzed as a function of dipole local time (DLT) under a broad range of magnetic activity. The perturbations are always transverse to the main field and thus result from field-aligned currents. During the period 1400 DLT through dusk to 2300 DLT the perturbation throughout the oval is directed eastward; the inferred field-aligned currents flow downward (into the ionosphere) in the equatorward part of the disturbance region and upward (out of the ionosphere) in the poleward part. During the epoch 2400 DLT through dawn to 1000 DLT the magnetic perturbation is westward and the current flow upward in the equatorward part and downward in the poleward part, characteristics reversed from those in the 1400–2300 DLT epoch. Either set can appear in the transition period, 2300–2400 DLT. From 1000 through noon to 1400 DLT the magnetic variations are still transverse and related to field-aligned currents but are relatively irregular in this continuously disturbed region. The diurnal pattern exists for all types of magnetic activity. Current densities lie mainly between 3×10^{-7} and 4×10^{-6} but can reach 5×10^{-5} A/m^2 and thus result from field-directed charges with fluxes principally between 2×10^{12} and 3×10^{13} but extending to 3×10^{14} particles/m^2 s. At a specific local time one sheet current of an oppositely directed pair could consist of precipitating (1) magnetosheath electrons, (2) electrons with an inverted V spectrum, or (3) plasma sheet electrons. In each case the companion return current is probably formed by ambient ionospheric electrons and/or positive ions. (auth)

30772 ELECTRIC FIELD MEASUREMENTS ACROSS THE HARANG DISCONTINUITY. Maynard, N. C. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 79: No. 31, 4620-4631(1 Nov 1974).

The Harang discontinuity, the area separating the positive and negative bay regions in the midnight sector of the auroral zone, is a focal point for changes in behavior of many phenomena. Through this region the electric field, in a frame corotating with the earth, rotates through the west from a basically northward field in the positive bay region to a basically southward field in the negative bay region, appearing as a reversal in a single-axis measurement of the north-south component. Thirty-two of these reversals have been identified in the Ogo 6 data from November and December 1969. The discontinuity is dynamic in nature, moving southward and steepening its latitudinal profile as magnetic activity is increased. As activity decreases, it relaxes poleward and spreads out in latitudinal width. It occurs over several hours of magnetic local time. The boundary in the electric field data is consistent with the reversal of ground magnetic disturbances from a positive to negative bay condition. The discontinuity is present in the electric field data both during substorms and during quiet times and appears to define a pattern on which other effects can occur. (auth)

30773 INCOHERENT SCATTER RADAR OBSERVATIONS OF WESTWARD ELECTRIC FIELDS. II. Rino, C. L. (Stanford Research Inst., Menlo Park, CA); Wickwar, V. B.; Banks, P. M.; Akasofu, S. I.; Rieger, E. J. Geophys. Res.; 79: No. 31, 4669-4678(1 Nov 1974).

The results of a series of geomagnetic meridian plane radar incoherent scatter plasma transport measurements are described. From such data the eastward (zonal) component of the electric field can be deduced. The results show that the electric field has an eastward component whenever the discrete auroras are northward of the region of the measurement. The zonal field component turns westward as the discrete auroras move equatorward of the region of the measurement. Thus there is an eastward electric field boundary near the equatorward limit of the discrete aurora, which is the poleward boundary of the diffuse aurora during undisturbed periods. During a particularly disturbed period we also observed three pronounced substorm-related enhancements of the westward-directed zonal field. For midnight and morning sector substorms the enhancements preceded the substorm onset times by 20–30 min. It is shown from meridian chain all-sky camera data that all three enhancements coincided with equatorward expansions of the auroral oval. (auth)

30774 ELECTRIC FIELDS DEDUCED FROM THE THERMOSPHERIC MODEL. Matuura, N. (Radio Research Labs., Tokyo). J. Geophys. Res.; 79: No. 31, 4679-4689(1 Nov 1974).

Dynamo effects arising from the horizontal pressure gradient force of the thermosphere are investigated theoretically. The global thermospheric model used in the derivation of the dynamo current is such that the thermosphere varies horizontally only in the diffusosphere above the turbopause level (assumed to be at 110 km), although the effects of the variation of the turbosphere temperature are briefly discussed. It has been shown that the dynamo current integrated along the magnetic field lines amounts to the order of 10 A/km, which is comparable to the Sq current. A major portion of the integrated dynamo current provides a two-dimensionally irrotational, or divergent, component that gives rise to the polarization electric field, so that the divergent component may be canceled by the return current's flowing mainly at the highly conductive E region under the influence of the polarization electric field and also flowing along the field lines under the influence of the field-aligned component of the electric field at extremely small magnitudes. The plasma drifts driven by the electric field obtained from the present model suggest the important role of the F region dynamo, especially upon phenomena such as the equatorial evening enhancement of the vertical drift revealed

30775 RADAR AURORAL ECHO CHARACTERISTICS AS SEEN BY A 398-MHz PHASED ARRAY RADAR OPERATED AT HOMER, ALASKA. Tsunoda, R. T.; Presnell, R. I.; Leadabrand, R. L. (Stanford Research Inst., Menlo Park, CA). J. Geophys. Res.; 79: No. 31, 4709-4724(1 Nov 1974).

The first results of the mapping of the spatial distribution of auroral echoes by a 398-MHz phased array radar recently installed at Homer, Alaska are presented. The results are shown in the form of two-dimensional spatial maps of auroral echoes. These maps are classified into types that are extensions of the "diffuse" and "discrete" echo types introduced by Leadabrand et al. (1959) and Presnell et al. (1959) for narrow beam radars. The auroral echo signatures typically seen during the afternoon and evening sectors are then described and discussed in relation to radar auroral echo characteristics found by previous investigations and other auroral processes. It is shown that interpretation of the occurrence of auroral echoes in terms of control by an electric field and by electron density in the radar scattering volume produces a consistent morphology of the radar aurora in relation to the other observed auroral processes. Finally, a dynamic auroral echo signature that may be related to the growth phase of an auroral substorm is included. (auth)

30776 JOINT RADAR-SATELLITE DETERMINATION OF THE EFFECTIVE RECOMBINATION COEFFICIENT IN THE AURORAL E REGION. Watt, T. M. (Stanford Research Inst., Menlo Park, CA); Newkirk, L. L.; Shelley, E. G. J. Geophys. Res.; 79: No. 31, 4725-4731(1 Nov 1974).

The experimental determination of the effective recombination coefficient α in the auroral E region is reported. The technique consists of obtaining measurements, time coincident and nearly space coincident, of electron density from the Chatanika incoherent scatter radar and of electron production rate from the 1971−089A satellite. Electron density profiles are determined along the radar beam, and electron production profiles are field aligned. The horizontal separation caused by these and other factors can give rise to uncertainties in the presence of horizontal gradients in electron density or production. Values of α obtained by this technique are nevertheless in reasonable agreement with the results of others. Since the technique offers the possibility of frequent and routine determinations of α profiles (typically, four per day), it clearly represents a powerful means for providing synoptic studies of this ionospheric parameter. (auth)

30777 FARLEY INSTABILITY: A LABORATORY TEST. D'Angelo, N. (Danish Space Research Inst., Lyngby); Pecseli, H. L.; Petersen, P. I. J. Geophys. Res.; 79: No. 31, 4747-4751 (1 Nov 1974).

An experiment is described that was performed in an alkali plasma (CS) device in order to test the theory of the Farley instability. With $v_{E\times B} > C_s$ (the speed of sound) and $\nu_i \gtrsim \omega_{ci}(\nu_e \ll \omega_{ce})$ wave excitation occurs, the waves traveling normal to the magnetic field B at the $v_{E\times B}$ speed. The perturbations are strongly elongated along the B field lines, with $\lambda_{||} \gg \lambda_{\perp}$. A comparison with theoretical predictions is gevin for the observed excitation conditions of the instability. (auth)

30778 TEMPERATURE DEPENDENCE OF SOME IONOSPHERIC ION-NEUTRAL REACTIONS FROM 300 TO 900°K. Lindinger, W.; Fehsenfeld, F. C.; Schmeltekopf, A. L.; Ferguson, E. E. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Geophys. Res.; 79: No. 31, 4753-4756 (1 Nov 1974).

A flowing afterglow system that operates from 300° to 900°K has been used to measure the temperature dependence of a number of aeronomically important reaction rate constants over this temperature range. This extends previous measurements in an earlier system that operated up to 600°K. The reactions measured include O^+ with N_2, O_2, and CO_2; N^+, N_2^+, and CO_2^+ with CO_2; O_2^+ with NO; and He^+ and He_2^+ and N_2. The measurements are compared with the previous measurements that exist and with measurements of rate constants as a function of ion kinetic energy alone. (auth)

30779 COMPUTATION OF WINDS AND ELECTROSTATIC FIELD FOR THE IONOSPHERIC DYNAMO. Petersons, H. F. (Australian National Univ., Canberra). J. Geophys. Res.; 79: No. 31, 4805-4806(1 Nov 1974).

A knowledge of the current density J, of the conductivity tensor [K], and of the geomagnetic flux density B enables one in theory to obtain for the ionospheric dynamo an estimate of the electrostatic potential S, apart from a constant, and hence the wind systems may also be obtained. This process requires a more accurate representation of the conductivity tensor and of the geomagnetic flux density than the representations that appear to have been used so far. (auth)

by Jicamarca data and the semidiurnal behavior of the plasma drift at middle latitudes indicated by Millstone Hill data. (auth)

30780 ANOMALOUS PHASE CHANGES OF TRANSEQUATORIAL VLF RADIO WAVES DURING GEOMAGNETIC STORMS. Araki, T. (Kyoto Univ.). J. Geophys. Res.; 79: No. 31, 4811-4816(1 Nov 1974).

Eight months of data for the relative phase of VLF signals from North West Cape, Australia (22.3 kHz), observed at Uji, Japan, are analyzed in order to detect geomagnetic storm effects on the low-latitude lower ionosphere. Anomalous phase decreases are found in the nighttime in association with the main phase of two large geomagnetic storm groups. The corresponding changes in the ionosphere are discussed on the assumption that the first and second modes exist in the nighttime earth-ionosphere wave guide. The situation is very complicated because the propagation parameters vary along transequatorial paths, but it is likely that the observed phase changes correspond to an increase in the ionospheric reflection height. (auth)

30781 $O_2(b^1\Sigma_g^+) - X(^3\Sigma_g^-)$ SYSTEM IN AURORA. Jones, A. V.; Gattinger, R. L. (National Research Council of Canada, Ottawa). J. Geophys. Res.; 79: No. 31, 4821-4822(1 Nov 1974).

Emissions from the O_2 atmospheric band system with $\nu' \leq 5$ have been identified in auroral spectra, contrary to the previous belief that only bands with $\nu' \leq 2$ were present. The intensities of the observed bands, referred to I(5577), have been determined for medium intensity aurora. Excitation mechanisms involving energy transfer from $O(^1S)$, $N(^2D)$, and $O(^1D)$ have been considered. (auth)

30782 MEASUREMENT OF IONOSPHERIC PARAMETERS BY SATELLITE SIGNALS. Kapanin, I. I.; Mizun, Yu. G.; Misyura, V. A.; Podnos, V. A.; Tyrnov, O. F.; Tsymbal, A. M.; Yagovkin, A. R. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 527-530 (1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 577-580(1974).

Measurements of ionospheric electron content and its horizontal gradients at middle and high latitudes are presented and analyzed. The data were obtained from signals of the satellites Interkosmos 2, Kosmos 321, Kosmos 381, Interkosmos 8, and Transit in the period 1970−1973. (auth)

30783 MIDDLE-LATITUDE DROPS IN LIGHT-ION CONCENTRATION FROM MASS SPECTROMETER READINGS OF SATELLITE OREOL 1. Ershova, V. A.; Sivtseva, L. D. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 523-526(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 572-576(1974).

In an experiment aboard the satellite Oreol 1 the L-coordinates of the drops in concentration of the light ions H^+ and He^+ in the subauroral ionosphere were measured. It was found that these drops are constant characteristics of the subauroral ionosphere during winter and night. The fine structure of the drops was discovered: the minimum He^+ ion concentration is located approximately 1.5° (~0.5L) to the south (toward the equator) of the minimum H^+ concentration. The positions of the minima have a clear inverse correlation with the values of the K_p indices. Within the limits of uncertainty, estimates of the plasmopause boundary by terrestrial observations of low-frequency radiation show satisfactory agreement between plasmopause positions and the middle latitude drops. Comparison with terrestrial spectrographic measurements in Yakutsk indicates that the night sky emission in the 6300 Å oxygen lines is sharply decreased in the drop region. Cases were discovered of H^+ and He^+ ion currents with superthermal velocities directed toward the earth. (auth)

30784 OUTBURST OF HIGH-ENERGY PROTONS DURING GEOMAGNETIC-INDEX DEPRESSIONS. Gotselyuk, Yu, V.; Kuznetsov, S. N.; Logachev, Yu. I.; Stolpovskii, V. G. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 511-517(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 558-565(1974).

Data are discussed about the observations of protons with energies > 1.0 MeV at ionospheric altitudes, obtained in the second half of November 1970 by the artificial earth satellite "Kosmos 378." The time dependences are derived for the proton intensity (at $L \geq 3$) and their angular distribution characteristics. It is noted that during magnetospheric storms (on the nocturnal side of the earth), the flux of protons with small pitch-angles increases sharply (by a factor of ~100 or more). Possible mechanisms are considered which lead to the outpouring of protons into the radiation belts. (auth)

30785 STUDY OF SOLAR PLASMA NEAR MARS AND ON EARTH−MARS ROUTE USING CHARGED PARTICLE TRAPS ON SOVIET SPACECRAFT IN 1971 TO 1973. II. Characteristics of Electrons Along Orbits of Artificial Mars Satellites Mars 2 and Mars 3. Gringauz, K. I.; Bezrukikh, V. V.; Breus, T. K.; Verigin, M. I.; Volkov, G. I.; D'yachkov, A. V. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 535-546(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 585-599(1974).

The results of measurements of the characteristics of the electron component of the solar wind and circumplanetary plasma using charged particle traps with retarding potentials mounted on artificial satellites of Mars — the craft Mars 2 and Mars 3 — are presented. A circumplanetary shock wave is found behind whose front there are considerable increases in the electron concentration n_e and temperature T_e, and electrons with energies of ≳50–70 eV are recorded. The average distance from the surface of Mars to the shock wave front is estimated as ~2500 km, and the distance to the obstacle producing the shock wave is 1400 km. If it is assumed that the obstacle is the planet's internal magnetic field which has a dipole nature, then an estimate of the magnetic moment of Mars gives $2.4 \cdot 10^{22}$ G · cm^3, which agrees with the value given by Dolginov et al. according to the data of magnetic measurements made on the same Mars satellites. (auth)

30786 COMBINATION FREQUENCIES IN THE INTERACTION BETWEEN HIGH-POWER SHORT-WAVE RADIATION AND IONOSPHERIC PLASMA. Getmantsev, G. G.; Zuikov, N. A.; Kotik, D. S.; Mironenko, L. F.; Mityakov, N. A.; Rapoport, V. O.; Sazonov, Yu. A.; Trakhtengerts, V. Yu.; Eidman, V. Ya. JETP Lett. (USSR) (Engl. Transl.); 20: No. 4, 101-102(20 Aug 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 4, 229-232(20 Aug 1974).

Emission due to quadratic nonlinearity in the ionosphere was observed at the modulation frequency of a high-power short-wave transmitter. The transmitter delivered an average power of 130 kW at 5.75 MHz to an antenna with a vertical directivity pattern. The antenna gain was G ≈ 150. A signal with field intensity E ~ 0.02 μ/m was registered in daytime at transmitter modulation frequencies from 1.2 to 7 kHz at a distance 180 km. It is shown that the principal role in the formation of the combination-frequency signals is played by the heating nonlinearity in the ionosphere D layer. (auth)

30787 DETERMINATION OF D-REGION ELECTRON LOSS RATES FROM VLF MEASUREMENTS DURING SID EVENTS. Bjoentegaard, G. (Norske Institut for Kosmisk Fysikk, Oslo). Geophys. Norv.; 30: No. 5, 31-60(1973).

X-ray fluxes in the frequency bands 0.5 to 3 and 1 to 8 Å measured in the spaceprobe Solrad 9 are used to calculate electron production in the lower ionosphere during solar flare events. Models for calculating the resulting VLF phase and amplitude changes are developed. This is done both for propagation over long paths (> 4000 km) where a fast procedure for solving the mode equation is worked out, and for paths shorter than 500 km where geometrical optics with two hops are used to describe the propagation. Six flare events are studied: three where VLF recordings were made over long, mid-latitude paths, and three events over a short, high latitude path. By comparing calculated and measured VLF phase and amplitude, quiet electron density profiles, effective recombination coefficients α', and effective attachment-detachment coefficient β' are deduced. It is concluded that $\alpha' = (5 \pm 2) \cdot 10^{-6}$ cm$^3 \cdot$ s^{-1} at (60-65) km altitude. This is in good agreement with measured values for water cluster ions in the lower ionosphere. It is furthermore estimated that $\beta' = (2 \pm 1) \cdot 10^{-34}$ cm$^6 \cdot$ s^{-1} below 60 km altitude and that the electron density profile has a C-layer of maximum 40-200 electrons pr.cm^3 at (60-65) km altitude. (auth)

30788 REVIEW OF THE USE OF MAN-MADE VLF RADIO WAVES IN LOWER IONOSPHERIC RESEARCH. Bjoentegaard, G. (Norske Institut for Kosmick Fysikk, Oslo). Geophys. Norv.; 30: No. 5, 1-12(1973).

The main VLF radio-wave techniques used in lower ionospheric research are briefly reviewed. The types of observations are divided into two groups according to which model is used to describe the propagation: (a) measurements over propagation paths shorter than 1000 km where ray theory is used, and (b) measurements over paths longer than 1000 km where the propagation is best described by mode theory. The emphasis is put on presenting results rather than describing theoretical models. (auth)

Magnetospheric Phenomena

Refer also to abstract 30771.

30789 (AAS-74-162) MAGNETOSPHERIC PARTICLE COMPOSITION EXPERIMENT. Geiss, J.; Lind, D. L.; Stettler, W. (American Astronautical Society, Tarzana, Calif.). 1974. 19p. (CONF-740839-2).

From 20th annual AAS skylab results meeting; Los Angeles, California, USA (20 Aug 1974).

Thin foils of aluminum and platinum were mounted on the exterior of the Skylab spacecraft where they were bombarded by particles that penetrate to the 400-km spacecraft altitude, including auroral particles precipitating from the magnetosphere. These foils have a high trapping efficiency for both charged and neutral particles above the 1 keV and a decreasing but appreciable efficiency below that energy. Some sections of the foils were double layered to obtain an estimate of the energy of the entrapped particles. Five cylindrically shaped foils were exposed between May 14, 1973, and February 3, 1974. Exposure times were 84, 84, 47, 181, and 73 days. The foils were retrieved and returned for analysis in an ultra-high-vacuum mass spectrometer. So far, the noble gas components of the entrapped particles have been analyzed in selected sections of two foils. ^{4}He, ^{3}He, ^{20}Ne, and ^{22}Ne have been detected. Relative to ^{4}He, sufficient ^{3}He is present to identify the precipitation of particles of solar-wind origin. (auth)

30790 (NDRE-66) HIGH LATITUDE OBSERVATIONS OF ELECTRONS ABOVE 40 keV ENERGY BY THE ESRO 1A AND 1B SATELLITES. Wedde, T. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). 19 Feb 1975. 116p. Dep. NTIS (US Sales Only) $9.00.

Some characteristics of the high-latitude population of greater than 40 keV electrons have been investigated by the low polar-orbiting satellites ESRO 1A/Aurorae and ESRO 1B/Boreas during 1968 to 1970. Median and upper quartile morphology maps for precipitated and trapped electron fluxes have been constructed from some one thousand passes of Aurorae over the northern hemisphere. Three ranges of Kp have been used in describing the level of disturbance of the magnetosphere. A number of individual passes has been presented, showing good correspondence between the statistical and observed structures during geomagnetically quiet periods. A region of enhanced flux has been encountered in the morning sector, it being associated with the mantle aurora. The shape and magnitude of the pitch angle diffusion coefficient have been derived, differing from previous findings. Hemispherical and longitudinal asymmetries in various high-latitude phenomena have been treated in the light of pitch angle diffusion. (auth)

30791 (NICP-7404) LOW FREQUENCY WAVES IN THE MAGNETOSPHERIC NEUTRAL SHEET. Bjoentegaard, G. (Norske Institutt for Kosmisk Fysikk, Oslo). Sep 1974. 22p. Dep. NTIS (US Sales Only) $4.50.

The generation and stability of waves in an electron beam in the neutral sheet of the geomagnetic tail is investigated using the Vlasov–Maxwell set of equations. The method of solution is similar to Bowers', but, while his approach was to simplify the system and solve instability criteria analytically, numerical calculation of the perturbed distribution function is dealt with here. The derivation of the model is presented, and an example of the calculations given. This investigation of one set of steady state parameters shows that electrostatic waves exist in the frequency range 0.1 to 1 kHz, with phase velocities ~10^8 m/s. The wavelength for those waves in the z-directions is very short, a few hundred meters in this model. Suggestions for further work are made. (NORW)

30792 (UCRL-51710) ENERGETIC ELECTRONS IN THE INNER BELT IN 1968: FITS TO LAWRENCE LIVERMORE LABORATORY'S MAGNETIC ELECTRON SPECTROMETER DATA OBTAINED ON OGO-5. Buck, R. M.; West, H. I. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Dec 1974. Contract W-7405-eng-48. 82p. Dep. NTIS $5.45.

Pitch-angle data were obtained by the Lawrence Livermore Laboratory's magnetic electron spectrometer on OGO-5 during its traversals of the inner radiation belt March 1968 through January 1969. Data from the five lowest-energy channels, 79 to 822 keV, were analyzed in terms of time decay vs invariant latitude at constant L. This document contains the details of fitting the data at L = 1.3, 1.35, 1.4, 1.5, etc. to 2.4. (auth)

30793 INFLUENCE OF SOLAR WIND VARIABILITY ON GEOMAGNETIC ACTIVITY. Garrett, H. B.; Dessler, A. J.; Hill, T. W. (Rice Univ., Houston, TX). J. Geophys. Res.; 79: No. 31, 4603-4610(1 Nov 1974).

A statistical study of solar wind data from the Explorer 33 satellite shows that interplanetary magnetic field irregularities are enhanced in the interaction region where a fast solar wind stream overtakes a slower solar wind stream. Comparison with geomagnetic AE and ap indexes further shows that these interplanetary irregularities enhance the level of geomagnetic disturbances. Thus while substorm occurrence is highly correlated with the dawn-dusk component of the solar wind $v \times B$ electric field, the amplitude of the substorms is an increasing function of the variance in the in-

terplanetary field. This result can be interpreted as a capacitative effect of the magnetopause that allows a time-varying solar wind electric field to penetrate the magnetosphere more effectively than a static solar wind electric field. On the basis of a simple physical model a capacitative time constant of the order of 20 min, consistent with the experimental results reported here is estimated. (auth)

30794 ELECTROMAGNETIC VIBRATIONS OF PLASMA WITH THE PRESENCE OF EXTERNAL HIGH-FREQUENCY RADIATION. Izmailov, I. A.; Yukhimuk, A. K. (Inst. of Geophysics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 8, 1381-1384(Aug 1974). (In Russian).

The electromagnetic instabilities of plasma in the presence of an external magnetic field are examined. A Maxwell plasma placed in a homogeneous magnetic field on which an external electromagnetic field is imposed is considered. In the second part it is assumed that the distribution function of electrons is double Maxwellian. The oscillation frequencies and build-up increments were found. The results obtained were used for the interpretation of some geophysical phenomenon in the magnetospheric plasma. (tr-auth)

30795 FLUX DENSITY OF ELECTRONS WITH E ≥ 80 MeV AT HEIGHTS OF 250 TO 300 km ABOVE THE BRAZIL ANOMALY. Basilova, R. N.; Savenko, I. A.; Kalinkin, L. F.; Pugacheva, G. I. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 576-577(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 632-633(1974).

In order to account for the observed flux of high-energy electrons by diffusion from the inner radiation belt, one must assume that the flux of electrons with energies $E_e \gtrsim 10^8$ eV considerably exceeds the flux of electrons appearing as excess radiation. However, electrons with energies of order 10^8 eV in the inner radiation belt have not been investigated experimentally. It is therefore necessary to evaluate the flux density of these high-energy electrons in the inner belt. A telescope containing scintillation and Cherenkov counters, with its aperture periodically occluded by a lead filter, has not been used to measure the electron flux density in the vicinity of the Brazil anomaly. The instrument was carried by the Kosmos 490 satellite. Measurements were taken on May 17-24, 1972. Perigee of the satellite was 210 km; apogee, 305 km; and the orbit inclination, 65°. The satellite crossed the Brazil-anomaly region six times daily. The telescope was pointed vertically upward and its aperture angle was ±15°. (MHR)

30796 MEASUREMENTS OF CHARGED-PARTICLE CURRENT DISTRIBUTIONS BELOW THE RADIATION BELTS BY THE SATELLITE INTERKOSMOS 3. Bano, M.; Vakulov, P. V.; Vanichek, L. Cosmic Res. (USSR) (Engl. Transl.); 12: No. 4, 518-522(1974).

Translated from Kosm. Issled.; Vol. 12: No. 4, 566-571(1974).

Various characteristics of particle currents recorded beneath the radiation belts in the region L ≤ 3 are examined. In the process of outflow of electrons with energy $E_e \geq 40$ keV from the radiation belts, a gradual accumulation occurs, leading to a significant dependence on longitude. The major portion of the outflowing electrons is lost in the region of the Brazilian magnetic anomaly during drift about the earth, where the electron trajectories descend into the atmosphere. Averaged data for the magnetic storm period of October 16-17, 1970 are presented. Growth in number of outflow electrons with increase in the parameter L was observed. Data on penetrating particle currents (cosmic rays and secondary radiation) are presented as functions of L. The satisfactory agreement of these data with those obtained in the 19th 11-year sunspot cycle in 1959-60 is noted. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 31643.

30797 (COO-2326-7) DEVELOPMENT OF A SUPERTHERMAL HIGH-INTENSITY SOURCE OF HYDROGEN ATOMS. Progress Report, July 29–August 2, 1974. Way, K. R.; Yang, S. C.; Stwalley, W. C. (Iowa Univ., Iowa City (USA). Dept. of Chemistry). [nd]. Contract AT(11-1)-2326. 2p. (CONF-740748-1). Dep. NTIS $4.00.

From conference on the dynamics of molecular collisions; Santa Cruz, California, USA (29 Jul 1974).

A stable high intensity source of hydrogen atoms for molecular beam studies is described. The performance and operation in this source are discussed. (JFP)

30798 ENERGY ANALYSIS OF LARGE–ANGLE keV ELECTRON SCATTERING FROM SOLID TARGETS. Schmoranzer, H.; Grabe, H.; Schiewe, B. (Fachbereich Physik, Universität Kaiserslautern, D–675 Kaiserslautern, Germany). Appl. Phys. Lett. 26: No. 8, 483-485 (15 Apr 1975).

In a new technique for studying the scattering of fast electrons ($E_0 \geq 10$ keV) into large angles ($\theta > \pi/2$) from solid targets the intensity and the energy distribution of scattered electrons are analyzed by means of silicon surface barrier detectors in the single–electron counting mode. Results of such studies at a scattering angle of 108° are reported for self–supporting gold foils of various thicknesses between 230 and 1505 Å. The high–intensity measuring accuracy recommends this method for precision determination of foil thicknesses. (auth)

30799 ROTATIONAL TRANSITIONS IN MOLECULE-SOLID SCATTERING. Wolken, G. Jr. (Battelle Memorial Institute, Columbus, Ohio 43201). J. Chem. Phys. 62: No. 7, 2730-2735 (1 Apr 1975).

A quantum mechanical calculation of the collision of H_2 with the (001) face of LiF has been carried out and compared with recent experimental data in which rotational transitions were resolved. A simple model potential accounts quantitatively for many of the observed effects. Refined potential parameters are extracted, and the effects of some of these parameters on rotational transitions are discussed. (auth)

30800 SIMPLE SYSTEM FOR PRODUCING AN ATOMIC BEAM OF ALKALINE EARTH METASTABLES. Heider, S.M.; Brink, G.O. (State University of New York at Buffalo, Buffalo, New York 14214). Rev. Sci. Instrum. 46: No. 4, 488-489 (Apr 1975).

A simple system is described which produces an intense atomic beam of alkaline earth atoms in metastable states. This system, which used an arc discharge in the effusion orifice of the atomic beam oven, has been used in hyperfine structure investigations of these states, as well as in the study of their scattering properties. (auth)

30801 MERGED BEAMS AT MINNESOTA. Gentry, W.R.; McClure, D.J.; Douglass, C.H. (Chemical Dynamics Laboratory, Chemistry Department, University of Minnesota, Minneapolis, Minnesota 55455). Rev. Sci. Instrum. 46: No. 4, 367-375 (Apr 1975).

A new merged-beam apparatus is described, which permits the measurement of the energy dependence of the absolute cross sections for ion–neutral and neutral–neutral reactions yielding ionic products over the energy range <0.010 to ~10 eV. The apparatus has a somewhat different geometry than that of any previous merged-beam instrument and incorporates several innovations which facilitate the rapid measurement of relative cross sections, the accurate determination of the beam overlap integral, and the high-resolution measurement of the product energy distribution. The performance of the instrument is illustrated with data on the reaction $H^+_2 + H_2 \rightarrow H^+_3 + H$. (auth)

30802 RESPONSE FUNCTION OF A FINITE ELECTRON GAS. Toigo, F. (Univ., Padua). Nuovo Cim., B; 25B: No. 2, 557-570(11 Feb 1975).

The full response matrix of an idealized metal with two plane parallel surfaces is calculated in the RPA approximation using the equation of motion for the retarded density-density Green's function. The surfaces are approximated by infinite barriers and the induced charge density is related to the perturbing charge instead of the Hartree field. It is shown that the Hamiltonian of the system splits into two parts: one due to bulk interactions and the other to the presence of the surfaces. The response matrix is then formally calculated and surface plasmons are shown to be described by the poles of a function related to the response matrix. (auth)

30803 A LOOK AT THE SMALL–ANGLE END OF THE RUTHERFORD SCATTERING FORMULA. Kruse, O.E. (Department of Physics, Texas A&I University, Kingsville, Texas 78363). Am. J. Phys. 43: No. 4, 328-330 (Apr 1975).

The lowest possible angle of validity of the Rutherford scattering formula is determined on the basis of a simple hypothesis. The corresponding impact parameter is then obtained and related to the distance between scattering nuclei that would exist if the scattering foil could be compressed into a single layer of atoms arranged in a square array. (auth)

30804 SCATTERING OF HELIUM AND DEUTERIUM FROM SINGLE–CRYSTAL Pt(111) COMPARED FROM TWO DIFFERENT LABORATORIES. Bernasek, S.L.; Somorjai, G.A. (Department of Chemistry, University of California, Berkeley, California 94720); Merrill, R.P. J. Vac. Sci. Technol. 12: No. 2, 655-657 (Mar 1975).

The angular distrubutions of scattered beams of helium and deuterium from platinum (111) surfaces which are obtained by two different laboratories using different techniques are compared. A basis for quantitative comparison of such inter–laboratory results is proposed.(AIP)

30805 PRODUCTION OF SHORT-LIVED MOLECULES IN A MASS SPECTROMETER. Gray, J.; Tomlinson, R. H. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Chemistry). Int. J. Mass Spectrom. Ion Phys.; 15: No. 2, 121-131(Oct 1974).

A neutralization-reionization technique has been used to produce molecules and ions with short lifetimes in a mass spectrometer. Charge-transfer reactions with lithium vapour have been used to produce beams of He_2, HeH and HeD molecules. He_2 molecules are believed to be formed in bound metastable triplet states having lifetimes of the order of 10^{-3} sec. The HeH and HeD molecules are believed to be produced in bound doublet states which are not metastable but decay with a mean lifetime of the order of 2×10^{-9} sec. Similar procedures have produced no evidence for the existence of H_3, D_2H and D_3 molecules. A collisional dissociation technique has been devised which permits analysis of molecular ions in a mass spectrometer. Results obtained with He^+_2 ions are shown. (auth)

30806 BOMBARDMENT-INDUCED PHOTON EMISSION FROM Al AND Al_2O_3 TARGETS. Kelly, R.; Kerkdijk, C. B. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Surface Sci.; 46: No. 2, 537-557(Dec 1974).

Ion impact on Al has been described by several authors as leading to the ejection of excited neutral Al atoms which in turn decay with the emission of photons. A study of these photons as arising from 10 keV Ne bombardment of Al and Al_2O_3 has been undertaken. One group of experiments involved measuring photon intensities under conditions of equilibrium. By increasing either the currents or the oxygen pressure, the intensities approached a well-defined limit such as would be expected if the intensities were proportional to the steady-state oxygen coverage. Remarkable here is that a good description of the experimental results was obtained using a model in which photons are assumed to arise only in the presence of oxygen. A second group of experiments involved the measurement of photon transients. Beam interruption led, when bombardment was resumed, to a transient with a half-time of ~3 sec and which was attributed to the amount of oxygen adsorbed on the surface having increased. Changing the current or pressure caused a transient which was about 8 times longer and which was attributed to the amount of recoil-implanted oxygen having changed. There is a close parallel, in the case of bombarded Al, between photon and ion yields; thus, the yields of Al^+ and Al^{++} but not Al^{+++} are known to depend on the presence of oxygen. The role played by absorbed or recoil-implanted oxygen is shown to be consistent with the band structures of Al and Al_2O_3 provided the electron affinity of Al_2O_3 is ≤ 0.8 eV. (auth)

30807 CALCULATIONS OF ELASTIC SCATTERING OF He ATOMS BY A PAIRWISE INTERACTION WITH A LiF(001) CRYSTAL SURFACE. Tsuchida, A. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Surface Sci.; 46: No. 2, 611-624(Dec 1974).

By assuming a Lennard-Jones 12-6 potential between He and Li^+, and He and F^- in a LiF crystal, the specular and diffracted intensities of He from a LiF (001) crystal surface are obtained by direct integration of the coupled differential equations. Numerical results are obtained by using 3-29 partial wave models for glancing incidence at $\theta^i = 60$-90°. The 11 partial wave model gives fairly good results in comparison with other models having more waves. Experiments of Williams in which the incident conditions are varied by rotating the crystal are discussed. (auth)

30808 SEMICLASSICAL TRAJECTORY CALCULATIONS OF HELIUM SCATTERING FROM W(112). Masel, R. I.; Merrill, R. P.; Miller, W. H. (California Univ., Berkeley (USA)). Surface Sci.; 46: No. 2, 681-688(Dec 1974).

Preliminary results are presented of semiclassical trajectory calculations for helium scattering from the W (112) where specular scattering, (11$\bar{1}$) direction, and diffractive scattering, (1$\bar{1}$0) direction, are observed from the same surface. (auth)

30809 SELF-SPUTTERING OF Ge SINGLE CRYSTALS. Holmen, G. (Chalmers Tekniska Hoegskola, Goteborg). Radiat. Eff.; 24: No. 1, 7-11(1975).

Temperature dependence of self-sputtering in germanium was determined for the Ge (110), Ge (111) and Ge (100) surfaces. At room temperature the sputtering yield is 8 atoms/ion for all three surfaces bombarded by 50 keV Ge ions. At about 300°C the yield drops to 2.5 atoms/ion for the Ge (110) and Ge (111) surfaces and 2.9 atoms/ion for the Ge (100). The transition is caused by a change in the crystal order. A comparison with current sputtering theories is made. (auth)

30810 EXPERIMENTS ON A NEW SURFACE IONIZATION ION SOURCE WITH LITHIUM. Rasser, B.; Remy, M. (Univ., Nancy). Rev. Sci. Instrum.; 46: No. 3, 325-326(Mar 1975).

We have constructed a surface ionization ion source able to ionize many elements. Currents of 3 mA for Li^+ ions with a current density of 1.7 mA/cm^2 can be obtained. (auth)

30811 SPACE DISTRIBUTION OF ATOMS SPUTTERED FROM MONOCRYSTALLINE SILICON AND GERMANIUM TARGETS. Nizam, J.; Benazeth-Colombie, N. (Toulouse-3 Univ., 31 (France). Lab. de Physique des Solides). Compt. Rend., Ser. A, B; 278: No. 26, 1095-1098(24 Jun 1974). (In French).

The patterns of atoms sputtered from monocrystalline silicon and germanium targets are isotropic and typical of a disordered surface when the temperature of the target during bombardment is less than T_1 (200°C for Si and 170°C for Ge). Beyond this temperature the patterns are anisotropic. This anisotropy was interpreted in reference to the real surface structure patterns of the targets investigated on the one hand and the Lehmann and Sigmund theory on the other. (FR)

30812 DEFLECTING PRISM. Foulquier, H. (CEA, 75 - Paris (France)); Martin, Philippe; Pinard, Pierre (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). (to CEA, 75 - Paris (France)). French Patent 2,188,255/A/. 5 Jun 1972. 15p. (In French).

This prism is characterized in that it comprises a body of nonmagnetic material provided with means for securing an electron gun adapted to emit an electron beam of revolution about an axis. This beam flows along a duct provided in the prism-body and coaxial with said axis, this duct extending opposite said gun down to a slit acting as a gap between two identical parallel plane polar pieces forming part of a magnetic circuit and between which is generated a deflecting magnetic field at right angles to these polar pieces and to the beam axis, these polar pieces comprising end surfaces the normals of which are at given angles to the beam axis. This device can be applied to the welding of fuel elements. (FR)

30813 SIMPLE ANALYTIC EVALUATION OF FRACTION TRAPPED. Modak, A. T.; Pagni, P. J. (Lawrence Berkeley Lab., CA). J. Chem. Phys.; 62: No. 3, 1193-1195(1 Feb 1975).

An analysis predicting the fraction trapped, f_t, defined as the number fraction of a given incident beam trapped in a gas surface potential well during collision with the surface, has been reported [J. Chem. Phys.; 59: 2019(1973)]. In the present paper a simple analytic expression for fraction trapped is derived which allows a convenient yet accurate calculation of f_t for comparison with experiment. (2 figures) (RWR)

30814 INTERACTION OF RARE GAS ATOMS WITH GRAPHITE SURFACES. I. Single Adatom Energies. Freeman, D. L. (Battelle Memorial Inst., Columbus, OH). J. Chem. Phys.; 62: No. 3, 941-949(1 Feb 1975).

The Gordon–Kim local density method is applied to the calculation of the interaction energy of helium, neon, argon, and krypton with the basal plane of graphite. In all cases, the binding site is found to be above the center of a hexagon, but the barrier to migration to other sites is less than 50 cal/mole. Comparisons are made with other studies on these systems, and the role of non-two-body additive effects is discussed. (8 figures, 5 tables) (auth)

30815 CHARGE-NEUTRALIZATION PROCESSES FOR INTENSE RELATIVISTIC ELECTRON BEAMS IN LOW-PRESSURE NEUTRAL GASES. Olson, C. L. (Sandia Labs., Albuquerque, NM). Phys. Rev., A; 11: No. 1, 288-296(Jan 1975).

Processes affecting the charge neutralization of intense relativistic electron beams injected into low pressure neutral gases are investigated. Processes examined include electron impact ionization, electron avalanching, ion impact ionization, ion avalanching, charge exchange, precursor ionization effects, secondary-electron escape, recombination, diffusion, and attachment. Cross sections and analytic estimates are given for each process. The ion avalanche-like process is apparently new and unique to intense relativistic electron beams. Although omitted in past research, the ion ionization effects discussed can play dominant roles in the charge neutralization process. Pressures of the order of 0.1 Torr H_2 are considered specifically, but the results should apply at least qualitatively to even higher pressures and, with appropriate cross sections, to gases other than H_2. The results should have immediate relevance to the problems of collective ion acceleration with drifting intense beams, ion loading for the electron ring accelerator, and intense relativistic electron beam propagation in low pressure neutral gases. (auth)

30816 ANGULAR DISTRIBUTION AND PHOTOIONIZATION CROSS SECTION MEASUREMENTS ON THE 3P and 3S SUBSHELLS OF ARGON. Houlgate, R. G.; West, J. B.; Codling, K.; Marr, G. V. (Univ. of Reading, Eng.). J. Phys., B (London); 7: No. 17, L470-L473(1 Dec 1974).

The photoelectron angular distribution parameter β has been measured in the energy region 0 to 34 eV above threshold for argon 3p electrons, using a synchrotron light source. The cross section of the argon 3s subshell has also been measured in the 0 to 20 eV region above its threshold. Both sets of data are compared with recent theoretical calculations. (auth)

30817 ELECTRONIC MECHANISM FOR THE DISSOCIATION OF H_2^+ IONS BY COLLISIONS WITH INERT GAS ATOMS. Golubkov, G. V.; Dalidchik, F. I.; Ivanov, G. K.; Manakhov, L. V. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 4, 248-251(1974).

Translated from Khim. Vys. Energ.; 8: No. 4, 296-300(1974).

An electronic mechanism involving nonadiabatic transitions $1s\sigma_g \rightarrow 2p\sigma_u$ of the molecular ions is discussed with respect to the dissociation of H_2^+ ions by inert gas atoms. In the framework of the Landau–Zener model, for the case where the intersecting terms are represented by the surface of an elliptical dipolar cone, the general properties of the total cross section and the angular and energy distributions of the dissociation products are discussed. (auth)

30818 SET OF ACCURATE X RAY INTERACTION COEFFICIENTS FOR LOW ATOMIC NUMBER ELEMENTS IN THE ENERGY RANGE 4 TO 25 KEV. Millar, R. H.; Greening, J. R. (Univ. of Edinburgh). J. Phys., B (London); 7: No. 17, 2345-2354(1 Dec 1974).

By curve fitting routines, values of total attenuation cross section and photoelectric cross section for the elements C, N, O, F, Ne, Mg, Al, S, Cl, Ar in the energy range from 4.508 to 25.192 keV, for Si from 8.041 to 25.192 keV and for P from 11.210 to 25.192 keV have been derived, based on experimental measurements of high accuracy. These smoothed values have estimated 99% confidence limits of ±1%. This constitutes a substantial improvement on existing experimental data. The impressive agreement of these results with the theoretical data of Storm and Israel (Nuclear Data Tables A 7 (1970)) lends weight to the newer theoretical techniques. (auth)

30819 EXPERIMENTAL X RAY MASS ATTENUATION COEFFICIENTS FOR MATERIALS OF LOW ATOMIC NUMBER IN THE ENERGY RANGE 4 TO 25 keV. Millar, R. H.; Greening, J. R. (Univ. of Edinburgh). J. Phys., B (London); 7: No. 17, 2332-2344(1 Dec 1974).

Experimentally determined mass attenuation coefficients for C_2H_4, CO_2, N_2, O_2, CF_4, Ne, H_2S, HCl, Ar, air, Mg, Al, SiO_2, $(C_2H_5)_3PO_4$ at a series of energies from 4.508 to 25.192 keV are presented in tabular form, together with estimates of total random and systematic uncertainty. Full details of the experimental method are given. This data set enables deduction of a coherent data set for the elements from $Z = 6$ to $Z = 18$ with better accuracy, internal consistency and reliability than any previously published data in this energy and atomic number range. (auth)

30820 HYPERTHERMAL BEAMS SPUTTERED FROM ALKALIHALIDE SURFACES. Koennen, G. P.; Grosser, J.; Haring, H.; de Vries, A. E.; Kistemaker, J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). pp 13-31 of Energy Distributions of Sputtered Neutrals and Electron Transfer and Reactive Ionization in Atom–Molecule Collisions. Koennen, G. P. (ed.). Amsterdam; Stichting voor Fundamenteel Onderzoek der Materie (1974).

Velocity selected beams of atoms and molecules have been produced by sputtering from various alkali halide surfaces under 6-keV Ar^+ ion bombardment. The mass spectrum and the velocity distribution of these particles have been analyzed in the range from 0–13000 m/s. In the low-velocity part of the spectrum monatomic particles as well as polyatomic ones have been found. For velocities larger than 3000 m/s the number of sputtered molecules is very small compared to the number of atoms. In addition to typical sputtering velocity distributions, thermal distributions are also found, due to vaporization of the less effectively sputtered atoms from the crystals. Above a few eV the energy distribution of a given alkali or halogen atom is independent of the target from which it is sputtered. There are indications that some sputtered atoms and molecules are formed in long-lived excited states. (NL)

30821 ENERGY DISTRIBUTION OF SPUTTERED CLUSTERS. Koennen, G. P.; Tip, A.; de Vries, A. E. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). pp 32-51 of Energy Distributions of Sputtered Neutrals and Electron Transfer and Reactive Ionization in Atom–Molecule Collisions. Koennen, G. P. (ed.). Amsterdam; Stichting voor Fundamenteel Onderzoek der Materie (1974).

A theoretical expression is obtained for the energy distribution of sputtered clusters from crystal surfaces. The derivation is based on a model where the atoms which constitute a cluster, are sputtered independently from the crystal according to their respective single particle energy distribution functions. Simultaneously sputtered atoms are then supposed to form a cluster if the sum of their initial relative kinetic energy and potential energy is less than the lowest dissociation energy of the cluster. A comparison with experimental results for W_k ($k \leq 3$), K_2 and KI sputtered from polycrystalline W, K and KI surfaces, respectively, shows good agreement. For the ionic crystal KI, evidence is obtained that sputtering of K and I atoms which are not closest neighbors gives an important contribution to dimer formation. The role of the binding energy E_b of the particles with respect to the surface is discussed. (auth)

Atomic and Molecular Properties

Refer also to abstracts 30853–30855, 30876–30879, 30881, 30882, and 31664.

30822 (AED-CONF-74-306-011) RECENT FINE STRUCTURE MEASUREMENTS IN HYDROGEN LIKE ATOMS. Pipkin, F. M. (Harvard Univ., Cambridge, Mass. (USA). Lyman Lab. of Physics). 1974. 22p. INIS.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

The present state of knowledge of the hydrogen fine structure is summarized, the recent advances in technique which enable one to reduce the line width below the natural line width, are described, and methods on the horizon which give promise of even greater precision are outlined. (GE)

30823 (COO-1265-154, pp 150-160) MEASUREMENTS OF OPTICAL ISOTOPE SHIFTS IN ORDER TO STUDY NUCLEAR CHARGE DISTRIBUTIONS. Broadhurst, J. H.; Cage, M. E.; Clark, D. L.; Greenlees, G. W.; Griffith, J. A. R.; Isaak, G. R. Sep 1974.

In annual report 1974.

30824 (COO-3161-29) EXTENDED HUECKEL CALCULATION OF REPULSIVE INTERACTIONS IN NOBLE GASES. Hathaway, K. B.; Krumhansl, J. A. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Dec 1974. 17p. Dep. NTIS $4.00.

Repulsive potential energies for all of the possible pairs of atoms of the noble gases helium, neon, and argon are calculated by the semiempirical extended Hückel molecular orbital method. The agreement of the calculated energies with other theoretical results and experimental data is significantly improved by computing overlaps using analytic approximations to the atomic Hartree-Fock atomic orbitals instead of the more commonly used Slater functions. (auth)

30825 NUCLEAR AND ATOMIC MOMENTS AND HYPERFINE–STRUCTURE PARAMETERS OF ^{253}Es AND ^{254m}Es. Goodman, L.S.; Diamond, H.; Stanton, H.E. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. A 11: No. 2, 499-504 (Feb 1975).

The atomic–beam magnetic–resonance method has been used to study atoms of the isotopes ^{253}Es and ^{254m}Es. The parameters of the Hamiltonian which fit the experimental data for ^{253}Es are $I = 7/2$, $J = 15/2$, $A = 817.153$ (7) MHz, $B = -4316.254$ (76) MHz, $\mu_I = 4.10$ (7) μ_N, and $g_J = 1.185138$ (5). The spectroscopic nuclear electric quadrupole moment calculated from the B factor is $Q_S = 6.9$ (8) b. For ^{254m}Es the parameters $I = 2$, $A = 1020$ (12) MHz, and $B = -2387$ (160) MHz fit the data. The magnetic dipole moment and electric quadrupole moment inferred from these values are $\mu_I = 2.90$ (7) μ_N and $Q_S = 3.8$ (5) b. The high precision of the Landé g–value determination was used to calculate an atomic ground–state eigenvector. For ^{253}Es the ratio of the measured A factor to the nuclear magnetic moment agrees well with the calculations of Lewis *et al.* (auth)

30826 MULTICENTRIC EXPANSIONS FOR ISOSCELES $H_3^{+,+}$ CONFIGURATIONS. Hernández, J.A.; Carbó, R. (Sección de Química Cuántica, Departamento de Química Orgánica, Instituto Químico de Sarriá, Barcelona-17, Spain). J. Chem. Phys. 62: No. 7, 2637-2639 (1 Apr 1975).

Three, four, and ten center expansions, using Gaussian orbitals, have been used to study the isosceles energy maps of the $H_3^{+,+}$ ion. Results confirm the inexistence of a bound state, and are compared with those of other authors. (auth)

30827 CALCULATION OF MOLECULAR ELECTRIC POLARIZABILITIES AND DIPOLE MOMENTS. I. GENERAL THEORY AND APPLICATION TO THE HYDROGEN MOLECULE. Svendsen, E.N.; Hameka, H.F. (Department of Chemistry, University of Pennsylvania, Philadelphia, Pennsylvania 19104). J. Chem. Phys. 62: No. 7, 2760-2765 (1 Apr 1975).

We analyze a number of different procedures for calculating molecular electric polarizabilities. We find that one particular method should give reliable polarizability values for nonpolar molecules, having no permanent electric dipole. It seems questionable that this method will yield accurate polarizability values for polar molecules, but in that case it may be used to calculate the electric dipole moment. We use the method to calculate the electric polarizabilities of the hydrogen molecule and the hydrogen molecular ion and we obtain satisfactory results. (auth)

30828 DETERMINATION OF THE SIGN OF THE SPIN–SPIN INTERACTION IN $He_2(a^3\Sigma^+_u)$. Vierima, T.L. (Yale University, New Haven, Connecticut 06520). J. Chem. Phys. 62: No. 7, 2925-2926 (1 Apr 1975).

In a measurement of the radio-frequency transition spectrum of the $N=1$ and $N=3$ rotational levels of $He_2(a^3\Sigma^+_u)$ (probably $v=0$) in a molecular beam magnetic resonance experiment, we determined the finestructure spacings to within an inversion of the levels, and extracted the magnitude of the spin–spin interaction constant λ. This paper reports an independent determination of the level order, to obtain the sign of this interaction. (auth)

30829 NUCLEAR MAGNETIC SHIELDING IN THE HYDROGEN MOLECULE. Reid, R.V. Jr. (Department of Physics, University of California, Davis, California 95616). Phys. Rev. A 11: No. 2, 403-408 (Feb 1975).

Working within the adiabatic approximation in the gauge where the vector potential is zero at the nucleus, Ramsey's diamagnetic part of the shielding constant was calculated using an 87–term James–Coolidge–type wave function. The paramagnetic part of the shielding was determined by means of spin–rotation interaction and isotope–shift data. Results for the shielding constant in isotopes of the hydrogen molecule are reported for a range of temperatures between 0 and 500 K. For H_2 at 295 K and zero pressure, $\sigma = 26.366 \pm 0.070$ ppm was obtained, with the error meant to take at least partly into account presently uncalculated nonadiabatic and relativistic effects. This value is in agreement with $\sigma = 26.23 \pm 0.18$ ppm from experiment. (auth)

30830 REFERENCE WAVELENGTHS FROM ATOMIC SPECTRA IN THE RANGE 15 Å TO 25000 Å. Kaufman, V. (Institute for Basic Standards, National Bureau of Standards, Washington, D.C. 20234); Edlén, B. J. Phys. Chem. Ref. Data 3: No. 4, 825-896 (Dec 1974).

This is a compilation of atomic lines with accurately known wavelengths covering the range from 15 Å to 25000 Å. The tables are a fairly complete record of available spectrum lines that meet the requirements for useful references with regard to wavelength accuracy and intensity. In general, wavelength uncertainties range from 0.0001 Å to 0.002 Å. Section 1, $\lambda > 2000$ Å, gives λ_{air} and λ_{vac} for 3341 lines belonging to thirteen different spectra of ten elements. Section 2, $\lambda > 2000$ Å, contains 2091 lines belonging to 59 different spectra of 28 elements. The lines of section 2 are listed both by spectrum (i.e element and ionization stage) and in a finding list arranged in order of decreasing wavelength. Detailed explanations of the data and the sources used for the compilation are included. (auth)

30831 ANTICROSSINGS AND MICROWAVE TRANSITIONS BETWEEN THE $k\,(4p)\ ^3\Pi_u$, $v = 1$, $N = 3$ AND THE $p\,(4d)\ ^3\Sigma^+_g$, $v = 1$, $N = 5$ LEVELS OF H_2. Miller, T.A.; Freund, R.S. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 62: No. 6, 2240-2244 (15 Mar 1975).

Electric field induced anticrossings and electric dipole microwave transitions have been observed between the k (4p) $^3\Pi_u$, $v = 1$, $N = 3$ and the p (4d) $^3\Sigma^+_g$, $v = 1$, $N = 5$ levels of H_2. These $\Delta N = 2$ anticrossings are forbidden except for mixing with $N = 4$ levels by the magnetic field. Our observations show that at zero field the $^3\Pi_u$ $N = 3$ level lies 0.2785 ± 0.0001 cm^{-1} above the $^3\Sigma^+_g$ $N = 5$ level, a separation significantly smaller than the optical value of 0.38 cm^{-1}. Fine structure parameters for the k (4p) $^3\Pi_u$ state are consistent with values determined by MOMRIE from the $N = 1$ level. The magnetic g value and fine structure parameters for the p (4d) $^3\Sigma^+_g$ state show that it lies very close to Hund's case d. (auth)

30832 A DETERMINATION OF THE STABILITIES OF H^+_5, H^+_7, H^+_9, AND H^+_{11} FROM MEASUREMENT OF THE GAS PHASE ION EQUILIBRIA $H^+_n + H_2 = H^+_{n+2}$ (n = 3,5,7,9). Hiraoka, K.; Kebarle, P. (Chemistry Department, University of Alberta, Edmonton, Alberta, Canada T6G 2E1). J. Chem. Phys. 62: No. 6, 2267-2270 (15 Mar 1975).

The ion equilibria $H^+_n + H_2 = H^+_{n+2}$ for n = 3,5,7,9 were determined in a pulsed electron beam high ion source pressure mass spectrometer. Van't Hoff plots of the temperature dependence of the equilibrium constants $K_{n,n+2}$ lead to the corresponding ΔH°, ΔS°, and ΔG° changes. The ΔH values obtained were $\Delta H_{3,5} = -9.6$, $\Delta H_{5,7} = -4.1$, $\Delta H_{7,5} = -3.8$ $\Delta H_{9,11} = -2.4$ kcal/mole; $\Delta S^\circ_{3,5} = -24.6$, $\Delta S^\circ_{5,7} = -19.8$, $\Delta S^\circ_{7,9} = -20.2$, $\Delta S^\circ_{9,11} = -19.3$ e.u. (standard state 1 atm). These results are compatible with predictions from theoretical calculations in which the protonated hydrogen clusters are represented by a three center bonded H^+_3 to which H_2 molecules are weakly attached. The first three H_2 molecules go to the three corners of the H^+_3 triangle and the fourth goes to an outer position. (auth)

30833 ATOMIC PHYSICS WITH ION ACCELERATORS: BEAM-FOIL SPECTROSCOPY. Martinson, I. (Forskningsinstitutet foer Atomfysik, Stockholm (Sweden)); Gaupp, A. (Freie Univ. Berlin (F. R. Germany)). Phys. Rep.; 15: No. 3, 113-180(Dec 1974).

A survey is given of research in atomic spectroscopy with accelerated, excited ions (beam–foil spectroscopy). After a short experimental section recent studies of atomic energy levels (particularly multiply excited configurations), radiative transition probabilities, auto-ionization mechanisms, fine- and hyperfine-structure effects and radiative corrections are summarized. (auth)

30834 ISOTOPE EFFECT OF ION-ELECTRON EMISSION. Fehn, U. (Technische Univ. Muenchen (F. R. Germany)). Int. J. Mass Spectrom. Ion Phys.; 15: No. 4, 391-397(Dec 1974).

Mass discrimination of isotopes was investigated with the electron multiplier of an AEI MS 5 mass spectrometer. Ions of 15 elements ranging from Mg to Pb were measured on three dynode materials (CuBe, Al and Ni) in the energy range 7.0-8.6 keV. A nonlinear correlation between the ion-electron coefficient γ and the ion velocity v—$\gamma \sim v^b$—was found. The exponents b showed a decrease with increasing kinetic energy of the ions, a decrease with growing atomic number of the target material and a nonmonotonous increase with increasing atomic number of the ions. (auth)

30835 SPECTROSCOPY OF SUPERHEAVY TWO CENTRE ORBITALS. Mueller, B.; Smith, R. K.; Greiner, W. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 53: No. 5, 401-404(6 Jan 1975).

The inner shell molecular orbitals formed in heavy ion collisions become states of superheavy atoms as the two nuclei amalgamate. It is shown that there is a unique correspondence between the scattering energy, i.e., the distance of closest approach, and the shape of the molecular X-ray spectrum of a superheavy system. Thus, molecular spectroscopy can be used to investigate the shell structure of superheavy quasi-molecules and even, in the limit, of superheavy atoms. (auth)

30836 LONGITUDINAL RELAXATION TIME MEASUREMENTS IN HYDROGEN GAS MIXTURES AT LOW DENSITIES. Armstrong, R. L.; Kisman, K. E.; Kalechstein, W. (Univ. of Toronto). Can. J. Phys.; 53: No. 1, 1-4(1 Jan 1975).

Measurements of the longitudinal nuclear spin relaxation time through the region of the characteristic minimum at 49 MHz in mixtures of molecular hydrogen with the noble gases helium and argon and with molecular nitrogen are reported at 298 K. The data obtained serve as a further test of the basic approximations in the Bloom–Oppenheim theory and provide preliminary information concerning the role of inelastic collisions in the nuclear spin relaxation process. (auth)

30837 DIAGRAM FOR THE INTERPRETATION OF ISOMER SHIFTS IN TRANSITION AND RARE EARTH ELEMENTS WITH MOESSBAUER NUCLEI. Dautov, L. M.; Kadykenov, M. M.; Madiyanov, T. N.; Shinkeev, A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 73-75(1974). (In Russian).

The isomer shifts of Moessbauer atoms condensed in metals and compounds of different valencies were compared. The formal Moessbauer valency of the transition and rare earth elements in the metallic state was determined. This approach to the interpretation of the isomer shift is particularly useful in cases where there is only one stable valence state in the Moessbauer element. (tr-auth)

30838 THE HYDROGEN ATOM IN QUANTUM MECHANICS WITH NON-NEGATIVE DISTRIBUTION FUNCTION IN THE PHASE SPACE. Kruyshkine, V. V.; Zaparovanny, Yu. I. (Universitet Druzhby Narodov, Moscow (USSR)). Compt. Rend., Ser. A, B; 279: No. 2, 17-20(8 Jul 1974). (In French).

The energy levels of the hydrogen atom are calculated in the non-negative distribution function quantum mechanics. The results differ from those obtained by normal quantum mechanics and it is shown that this difference may be identified with the Lamb and Rutherford spectral shift. (FR)

30839 AUTOIONIZATION RESONANCES IN THE Eu I ABSORPTION SPECTRUM AND A NEW DETERMINATION OF THE IONIZATION POTENTIAL. Smith, G. (Oxford Univ.); Tomkins, F. S. Proc. Roy. Soc. (London), Ser. A; 342: No. 1628, 149-156 (25 Feb 1975).

The absorption spectrum of europium was studied at high resolution in the wavelength region between 2200 and 2100 A. Two Rydberg series were found converging towards the $^9S_4$ and $^7S_3$ levels of the configuration 4$f^7$6s in Eu II. The first series is perturbed near the series limit and the second shows strong autoionization features. A value of 45734.9 ± 0.2 cm^{-1} is deduced for the first ionization limit. (auth)

30840 ATOMIC PHYSICS OF CHANNELED PARTICLES. Kutcher, G. J. (Univ. of Florida, Gainesville). Phys. Rev., A; 11: No. 1, 125-134(Jan 1975).

The problem of the modification of the atomic structure of a hydrogenlike atom or ion as it is channeled through a thin single crystal is formulated. For high velocity channeling there is an approximate decoupling of the internal atomic motion and the solid state. This allows a single-particle equation to be written for the modified hydrogen atom. The effective potential in the equation is absorptive because of the ionization of the atom due to collisions with the solid. Effects of both single-particle and collective excitations are discussed. An approximate Schroedinger equation is derived for the atom, and solved approximately for the distorted states. (auth)

30841 EXPERIMENTAL DETERMINATION OF THE L_2–L_3X COSTER–KRONIG TRANSITION PROBABILITY IN EUROPIUM, PLUTONIUM, AND CURIUM. Zalutsky, M. R.; Macias, E. S. (Washington Univ., St. Louis). Phys. Rev., A; 11: No. 1, 71-74 (Jan 1975).

The L_2-L_3X Coster-Kronig transition probability for Z = 63, 94, and 96 was measured by the L-x-ray–K-x-ray coincidence technique. The value measured in ^{63}Eu was corrected for the presence of an unresolved $L\eta$ x-ray component in the $L\alpha$ x-ray group. The values reported are for ^{63}Eu, $f_{23} = 0.172 \pm 0.015$, for ^{94}Pu, $f_{23} = 0.233 \pm 0.015$, and for ^{96}Cm, $f_{23} = 0.226 \pm 0.017$. (auth)

30842 VARIABLE DIMENSIONALITY IN ATOMS AND ITS EFFECT ON THE GROUND STATE OF THE HELIUM ISOELECTRONIC SEQUENCE. Herrick, D. R.; Stillinger, F. H. (Bell Labs., Murray Hill, NJ). Phys. Rev., A; 11: No. 1, 42-53(Jan 1975).

Binding energies are calculated for heliumlike ions of variable dimensionality (D) with the wave functions $A = e^{(-\alpha R_1 - \beta R_2)} + e^{(-\beta R_1 - \alpha R_2)}$ and $B = A(1 + cR_{12})$. The binding energy decreases with increasing D. Functions A and B predict "critical binding dimensionalities" at D = 3.99 and 4.89, respectively, above which there is no binding in the hydride anion. The exact ground-state binding energy at D = 5 is shown to be equal to that of the doubly excited 2p^2 $^3P^e$ state in three dimensions. By "dimensionality scaling" of atomic units the D = 1 atom is transformed the δ-function model for which exact energies are known. In the infinite dimensional limit, function A predicts no exchange contribution to binding for nuclear charge $Z \geq \sqrt{2}$, with $\alpha \neq \beta$ only for $Z < \sqrt{2}$. (auth)

30843 HYPERFINE STRUCTURE AND ISOTOPE SHIFT OF THE 6s6p^2 $^4P_{5/2}$ LEVEL OF Tl I. Garton, W. R. S. (Imperial Coll. of Science and Tech., London); Reeves, E. M.; Tomkins, F. S. Proc. Roy. Soc. (London), Ser. A; 341: No. 1625, 163-166 (12 Nov 1974).

The hfs splittings and isotope shifts have been measured for the transition 6$s^2$6p^2 $^3P^0_{1/2}$-6s 6p^2 $^4P_{1/2}$ in Tl^{203}, Tl^{205}. These are the largest splittings occurring in the levels of Tl I. The results

agree in order of magnitude with splittings and shifts to be expected theoretically. The quartet level perturbs the n = 10 member of the $6s^2ns^2S_{\frac{1}{2}}$ series, which consequently acquires a large splitting and a measurable shift. (auth)

30844 MEASUREMENT OF THE HeI 4471 A PROFILE AT AN ELECTRON DENSITY OF 10^{15} CM^{-3}. Barnard, A. J.; Stevenson, D. C. (British Columbia Univ., Vancouver, Can.). J. Quant. Spectrosc. Radiative Transfer; 15: No. 1, 123-125(Jan 1975).

The profile of the HeI 4471 Å line and its forbidden component was measured using a pulsed arc plasma (electron density 10^{15} cm^{-3}, temperature 1.5 eV) as the light source. The profile is in good agreement with recent calculations in which the ion motion has been taken into account. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

30845 EFFECTS OF COLLISIONS ON THE MAGNETIC QUENCHING OF POSITRONIUM. Mills, A.P. Jr. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). J. Chem. Phys. 62: No. 7, 2646-2659 (1 Apr 1975).

A theory describing the behavior of positronium (Ps) in a magnetic field is presented including the effects of Ps collisions. Such effects are especially important if the Ps is formed in a medium containing unpaired electrons since Ps collisions with these electrons can provide an effective spin exchange mechanism. By integrating the equation of motion for the density matrix, it is shown that the dependence of any annihilation yield N on the static magnetic field x is of the form $N(x) = (g + hx + kx^2) / (l + mx^2)$ for a wide class of quenching mechanisms with time-independent reaction rates. The coefficients g, h, k, l, and m are evaluated explicitly for the 2γ and 3γ yields from Ps formed from polarized positrons assuming that the quenching mechanisms can be characterized by an effective spin exchange rate and an effective pickoff rate. The yields are also evaluated assuming zero positron polarization in formulas which include the interesting Ps chemical reaction rates directly. The formulas derived can be used to obtain information about such chemical reaction rates from magnetic quenching data. Diagrams which permit the quick estimation of magnetic quenching effects as a function of the quenching rates are presented. The formalism has also been extended to include an rf magnetic field and is used to compute the shift of the messured Ps hyperfine structure interval as a function of quenching and microwave power. The shifts are found to be extremely small as expected. (auth)

30846 EMISSION OF MIXED x-RAY ELECTRON RADIATION UPON PRODUCTION OF MUONIC URANIUM ATOMS. Arlt, R.; Ganzorik, Z.; Krogulski, T.; Ortlepp, H.; Polikanov, S.M.; Sabirov, B.M.; Fromm, V.D.; Schmidt, U.; Schneffi, G.; Engfer, R. (Joint Institute for Nuclear Research). JETP Lett. 20: No. 9, 291-292 (5 Nov 1974).

The emission of shifted x-ray electronic radiation was observed in the course of formation of muonic uranium atoms. (auth)

30847 ANGULAR CORRELATION OF COMPTON-SCATTERED ANNIHILATION PHOTONS AND HIDDEN VARIABLES. Kasday, L. R.; Ullman, J. D.; Wu, C. S. (Columbia Univ., New York). Nuovo Cim., B; 25B: No. 2, 633-660(11 Feb 1975).

The relative linear polarization of protons from two-quantum annihilation of positrons in copper was measured by Compton scattering. Measurements of the angular distribution of Compton-scattered photons arriving in coincidence were carried out over a wide range of scattering angles, both polar and azimuthal. The results agree with standard quantum-mechanical calculations assuming opposite parity of the electron and the positron. This result has implications regarding hidden-variable theories in quantum mechanics. A theorem by Bell restricts the values that any local hidden-variable theory can predict for certain relations between measurements made on correlated systems such as the photon pair from positron annihilation. It is shown that the distributions observed could not give results allowed by Bell's theorem if the photons were measured by ideal polarization analyzers, assuming the correctness of the usual quantum-mechanical Compton-scattering formulas. The results are thus evidence against local hidden-variable theories. (auth)

30848 POSITRON ANNIHILATION. Mijnarends, P. E. Atoomenergie Haar Toepass.; 17: No. 1, 19-24(Jan 1975). (In Dutch).

Summarizes historical development of positron-annihilation studies. Reviews recent measurements of annihilation half-lives, angular distributions, etc., in various metals and insulators. Discusses how such measurements may be utilized, in conjunction with appropriate theoretical models, to explore the microstructure of solids (or liquids) in which positron annihilation is observed. (FEG)

30849 MAGNETIC HYPERFINE STRUCTURE OF MUONIC ATOMS. Arima, A.; Fujita, T. (Tokyo Univ. (Japan). Dept. of Physics). v. 2 p. 580-598 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The distribution of nuclear magnetization densities is a natural extension of the problem of nuclear magnetic moments. This distribution can be deduced from 180° elastic electron scattering, although it is limited to light nuclei through the $0f_{\frac{7}{2}}$ shell and it is difficult to separate three magnetic multipole contributions (M1, M3 and M5) to the total magnetic cross section from each other. A muon in a muonic atom and electrons in a normal electronic atom produce magnetic fields which interact with nuclear current. This interaction is called magnetic hyperfine interaction. The magnetic hyperfine structure, which is sensitive only to the magnetic dipole field, is more suitable for the study of the magnetic dipole (M1) distribution than electron elastic scattering, although muonic atom experiments are limited to heavy atoms. These experiments, furthermore, have a bright future, because the new meson factories promise to extend the experiments to lighter nuclei. The problem of magnetic hyperfine structure is therefore reviewed. (auth)

30850 POSITRON ANNIHILATION RATE VARIATION IN THE PRESENCE OF ELECTRIC AND MAGNETIC FIELDS. Srivastava, M. P. (Univ. of Delhi); Grover, P. S. Can. J. Phys.; 53: No. 2, 133-139(15 Jan 1975).

The variation of the positron annihilation rate λ_a in noble gases He, Ne, and Ar was studied in the presence of an external applied magnetic field, when the electric field is kept constant. It is found that λ_a increases as the magnetic field is increased. In the case of Ar, the dependence is quite appreciable wherease in He and Ne it is comparatively smaller. (auth)

30851 BROMINE AND OXYGEN QUENCHING OF POSITRONIUM IN SILICA GEL. Chuang, S. Y.; Tao, S. J. (New England Inst. for Medical Research, Ridgefield, Conn. (USA)). Appl. Phys.; 3: No. 3, 199-204(Mar 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

Positron lifetime spectra for various concentrations of bromine and oxygen adsorbed on silica gel are investigated. Two-photon angular correlation experiments were also performed on some of these samples to study the quenching process of bromine and oxygen. The cross section for bromine quenching of orthopositronium in silica gel is about two orders of magnitude larger than that for oxygen quenching. The process of bromine quenching of positronium is found to be chemical quenching. Oxygen quenching of positronium in silica gel is found to be conversion quenching. The interaction between positronium and bromine or oxygen in silica gel is found to be similar to that found in the gaseous state. The energy of Ps annihilating in the pores of silica gels is found to be 0.25 ± 0.10 eV. (auth)

Collision Phenomena

Refer also to abstracts 30766, 30801, 31541, and 31661.

30852 (AD/A-000691) OPTICAL EXCITATION CROSS SECTIONS IN ATOMIC COLLISIONS OF HYDROGEN, MAGNESIUM, AND ATMOSPHERIC GASES. Final Report. St. John, R. M. (Oklahoma Univ., Norman (USA)). Sep 1974. 16p. (AFOSR-TR-74-1728). NTIS $3.25.

Research has been performed in the experimental and theoretical areas of electron-atom, electron-molecule, and atom-atom collisions involving H_2 dissociation, recombination of atomic hydrogen, wood discharge as a device for dissociation of H_2, secondary processes in an electron-atom collision region, electron impact excitation of H, electron impact excitation of H_2, electron impact dissociation of H_2, polarization measurement of light from collision chamber, transfer of excitation in helium, electron impact simultaneous ionization and excitation of neon, and electron impact excitation of magnesium atoms. (auth)

30853 (AED-CONF-74-306-006) THE DECAY OF THE NEUTRAL VACUUM IN OVERCRITICAL FIELDS. Mueller, B.; Smith, R. K.; Greiner, W. (Frankfurt Univ. (F.R. Germany). Inst. fuer Theoretische Physik). 1974. 67p. INIS.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

After a short introduction to the solutions of the Dirac equation for high Z values a discussion is given of the change of the vacuum in overcritical Coulomb fields ($Z\alpha > 1$) and of the effects of this vacuum polarization on the electromagnetic and spinor fields. These considerations are then applied to superheavy quasimolecules formed in heavy ion-ion collisions and to the properties of their X-ray emission. The problem of the induced decay of the neutral vacuum in overcritical fields is also discussed. (GE)

30854 (AED-CONF-74-306-007) RADIATIVE TRANSITIONS IN QUASI-MOLECULES. Saris, F. W.; de Heer, F. J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). 1974. 14p. INIS.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

A review is given of experimental studies of the continuum X-ray bands emitted by quasi-molecules which are formed during ion-atom collisions. The discussion is confined to data obtained at beam energies lower than 1 MeV. Furthermore, some prospects are briefly discussed of a direct experimental verification of calculated diabatic molecular orbitals. (GE)

30855 (COO-1265-154, pp 140-146) ATOMIC COULOMB IONIZATION FOR L-SUBSHELL IN HIGH-Z ELEMENTS BY CHARGED PARTICLE BOMBARDMENTS. Li, T. K.; Clark, D. L.; Greenlees, G. W. Sep 1974.

In annual report 1974.

30856 (COO-1265-154, pp 147-149) COINCIDENCE MEASUREMENT OF INELASTIC SCATTERING CORRESPONDING TO K- AND L-SHELL IONIZATION. Broadhurst, J. H.; Cage, M. E.; Clark, D. L.; Greenlees, G. W.; Griffith, J. A. R.; Isaak, G.; Li, T. K.; Moss, J. M. Sep 1974.

In annual report 1974.

30857 (FUPH-R-113) THEORY OF THE (e,2e) REACTION ON MOLECULES. [Part] II. McCarthy, I. E. (Flinders Univ. of South Australia, Bedford Park, School of Physical Sciences). Jan 1975. 13p. Dep. NTIS (US Sales Only) $4.00.

The theory of (e,2e) reactions given previously is modified in the light of experience with fitting data for atoms and molecules. The molecular orbitals are linear combinations of atomic orbitals in spherical polar coordinates. The general formulation is greatly simplified by using closure over unresolved rotational and vibrational states. Concrete examples of interest are formulated and discussed. (auth)

30858 EXPERIMENTAL INVESTIGATION OF ELECTRON LOSS AND CAPTURE BY FAST, UNEXCITED, AND METASTABLE HELIUM-LIKE IONS IN ION–ATOMIC COLLISIONS. Dmitriev, I. S.; Nikolaev, V. S.; Tashaev, Yu. A.; Teplova, Ya. A. (Inst. of Nuclear Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2047-2063(Dec 1974). (In Russian).

The mean cross sections for loss or capture of one or two electrons are determined for beams of helium-like particles containing a metastable component, the particles being produced as the result of loss of an electron by lithium-like ions and obtained by passing the fast particle beam through a thin celluloid film. From the results of these measurements the cross sections for electron loss or capture by unexcited helium-like ions are found and also the cross sections for electron loss by metastable helium-like ions with nuclear charges Z from 3 to 8 traversing helium or nitrogen with velocities varying between $4 \cdot 10^8$ and $12 \cdot 10^8$ cm/sec. The electron loss and capture cross sections thus obtained are compared with the cross sections for other simple atomic systems. The relative number of metastable particles in beams of helium-like ions produced in the indicated manner are determined. (auth)

30859 CROSS SECTIONS AND EQUILIBRIUM CHARGE FRACTIONS WHEN D_2^+ IS INCIDENT ON Cs VAPOR. Meyer, F.W.; Anderson, L.W. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. A 11: No. 2, 589-594 (Feb 1975).

The total cross section for charge exchange or breakup when D_2^+ is incident on Cs has been measured in the energy range 3.0–23 keV. The cross section has a value of $(1362 \pm 80) \times 10^{-17}$ cm^2 at 3 keV and falls rapidly with increasing energy, reaching a value of $(594 \pm 40) \times 10^{-17}$ cm^2 at 23 keV. The equilibrium fraction of D^- obtained when D_2^+ is incident on Cs has also been measured. The equilibrium fraction of D^- is (10.5 ± 2.0) % at 3 keV, (7.3 ± 1.6) % at 5 keV, (3.4 ± 0.7) % at 11.5 keV, (2.0 ± 0.4) % at 17.3 keV, and (1.5 ± 0.3) % at 23 keV. The equilibrium fracition of D^- obtained when D_2^+ is incident on Cs at an energy E is shown experimentally to be the same as the equilibrium fraction of D^- obtained when D^+ is incident on Cs at an energy E/2. The angular distribution of the reaction products when D_2^+ ions are incident on Cs includes appreciable scattering into angles which are larger than 1 °. An explanation of these large scattering angles is offered. (auth)

30860 CHARGE–EXCHANGE CROSS SECTIONS FOR Kr^+ AND Xe^+ INCIDENT ON Cs. Meyer, F.W.; Anderson, L.W. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. A 11: No. 2, 586-588 (Feb 1975).

Total charge–exchange cross sections for Kr^+ and Xe^+ incident on Cs have been measured. The energy of the incident ion was in the range 1.0–28.7 keV for Kr^+ and in the range 1.0–17.2 keV for Xe^+. The cross section σ_{+0} for Kr^+ incident on Cs is $(884 \pm 86) \times 10^{-17}$ cm^2 at 1.0 keV, and increases to $(1171 \pm 41) \times 10^{-17}$ cm^2 at 5.0 keV. From 5.0 keV up to 28.7 keV, the cross section lies between 1100×10^{-17} and 1200×10^{-17} cm^2. The cross section σ_{+0} for Xe^+ incident on Cs is $(942 \pm 53) \times 10^{-17}$ cm^2 at 1.0 keV, and increases to $(1297 \pm 71) \times 10^{-17}$ cm^2 at 7.2 keV. From 7.2 keV to 17.2 keV, the cross section lies between 1250×10^{-17} cm^2 and 1440×10^{-17} cm^2. (auth)

30861 (e,2e) REACTION IN INERT GASES: COPLANAR SYMMETRIC GEOMETRY. Ugbabe, A.; Weigold, E.; McCarthy, I.E. (School of Physical Sciences, The Flinders University of South Australia, Bedford Park, S.A., 5042, Australia). Phys. Rev. A 11: No. 2, 576-585 (Feb 1975).

The angular correlations and binding–energy spectra have been measured for electrons ejected from the valence shells of He, Ne, Ar, and Xe in the coplanar symmetric geometry. The data have been analyzed with the distorted–wave off–shell impulse approximation using the Hartree–Fock wave functions of Froese–Fischer. The sensitivity of the coplanar symmetric cross section to distortion of the electron waves has enabled us to verify that the distortion effects are small and consistent with the optical model for elastic scattering. Large correlation effects are observed in the xenon $5s^{-1}$ and argon $3s^{-1}$ states, but correlation is negligible for the neon $2s^{-1}$ state. Spectroscopic factors and single–particle binding energies are determined for the neon, argon, and xenon s states. (auth)

30862 STRUCTURE OF INERT GASES FROM THE (e,2e) REACTION. Weigold, E.; Hood, S.T.; McCarthy, I.E. (School of Physical Sciences, The Flinders University of South Australia, S. A. 5042, Australia). Phys. Rev. A 11: No. 2, 566-575 (Feb 1975).

The (e,2e) reaction is used to investigate the binding energies and angular correlations for electrons ejected from the 4p and 4s orbitals of krypton. Configuration interaction in the ion eigenstates is the dominant feature in the ejection of a 4s electron. Only (30 ± 3) % of the strength of the 4s hole state is contained in the ion eigenstate with the dominant configuration $4s4p^6\ ^2S_{1/2}$. The angular correlations calculated with the distorted–wave off–shell impulse approximation, and using the Hartree–Fock wave functions of Froese–Fischer, agree very well with the observed angular correlations. In addition, relative to a $4p^{-1}$ spectroscopic factor of unity, the $4s^{-1}$ spectroscopic factors for the various excited ion eigenstates sum to 0.99 ± 0.08. Data are also presented on the binding energies of electrons ejected from the outer s and p orbitals in neon and argon, and the role of configuration interaction in the s^{-1} states is discussed. Incident electron energies are approximately 200, 400, and 800 eV. (auth)

30863 DEPENDENCE OF THE K–SHELL IONIZATION PROBABILITY ON SMALL IMPACT PARAMETERS WITH 1– AND 2–MeV PROTONS. Chemin, J.F.; Roturier, J.; Saboya, B.; Dien, Q.T. (Institut National de Physique Nucléaire et de Physique des Particules, Centre d'Etudes Nucléaires de Bordeaux–Gradignan, Le Haut–Vigneau–33170 Gradignan, France); Thibaud, J.P. Phys. Rev. A 11: No. 2, 549-555 (Feb 1975).

The absolute impact–parameter dependence of K–shell ionization probability $I(p)$ has been measured in the range 10^{-13}–10^{-11} cm at incident proton energies of 1 and 2 MeV with Al, Cu, and Ti targets. We give a condensed survey of previous results showing that a detailed investigation of $I(p)$ behavior at very small impact parameters is required for a better understanding of this problem. Such a study provides a useful check on the accuracy of classical and semiclassical ionization theories in a region where they are more likely to fail. Our results, obtained by a coincidence method, are compared with the presently available theories: the binary–encounter approximation (BEA) and the semiclassical approximation. A systematic deviation is found between experimental and theoretical data which is not accounted for when relativistic effects and the actual projectile trajectory are included in the BEA model. (auth)

30864 $K\alpha$ SATELLITE X RAYS IN Al, Sc, AND Ti FOLLOWING BROMINE–ION BOMBARDMENT. Jamison, K.A.; Woods, C.W.; Kauffman, R.L.; Richard, P. (Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 11: No. 2, 505-508 (Feb 1975).

A curved crystal spectrometer has been used to resolve structure in $K\alpha$ x rays from thick targets of Al, Sc, and Ti following bromine–ion bombardment. We find that this structure is due to states with different

numbers of L-shell vacancies. From this we can deduce the relative intensities for single K- and multiple L-shell vacancy production as well as the number of M-shell vacancies of each KL^n configuration undergoing Kα x-ray emission. These results are compared to previous measurements with Br beams in which KL^n configurations could not be resolved. (auth)

30865 ROTATIONAL RESONANCES IN MOLECULAR SCATTERING OF ULTRA-LOW-ENERGY ELECTRONS. Garrett, W.R. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. A 11: No. 2, 509-515 (Feb 1975).

A detailed study is made of the nature of rotational Feshbach resonances in the elastic scattering of extremely low-energy electrons by diatomic polar molecules. The bound-state properties of an electron in the field of a dipole rotator, determined previously, are used in establishing the resonance behavior of elastic-scattering phase shifts in the energy region below the first rotational excitation threshold. Feshbach resonances of very narrow widths are found in partial-wave scattering channels with total angular momenta greater than zero when the strength of the interaction potentials is somewhat less than that necessary to yield bound states of the same symmetry type, and very much less than those necessary to yield a "bound state" of the projected Hamiltonian *QHQ*. The latter implies a non-negligible value of the resonance energy shift for polar molecules. (auth)

30866 CROSS SECTIONS FOR K-SHELL IONIZATION OF CH_4, N_2, AND Ne BY 50- TO 600-keV H^+ AND He^+ IMPACT. Stolterfoht, N.; Schneider, D. (Hahn-Meitner-Institut für Kernforschung Berlin GmbH, Berlin-West, Germany). Phys. Rev. A 11: No. 2, 721-723 (Feb 1975).

Absolute cross sections for K-shell ionization by 50- to 600-keV H^+ and He^+ incident on CH_4, N_2, and Ne were measured by Auger-electron spectroscopy. Previous results obtained in our laboratory for CH_4 and N_2 are compared with these new values which are measured with an improved apparatus. The projectile Z dependence of the cross section was reanalyzed using the new data. (auth)

30867 L-SUBSHELL IONIZATION BY PROTON AND ALPHA-PARTICLE BOMBARDMENT OF Ta, Au, AND Bi. Chang, C.N.; Morgan, J.F.; Blatt, S.L. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. A 11: No. 2, 607-618 (Feb 1975).

Cross sections for ionization of the L_I, L_{II}, and L_{III} subshells in Ta, Au, and Bi have been measured for proton energies from 1.0 to 5.5 MeV and α-particle energies from 1.0 to 11.0 MeV. X-ray spectra recorded with a Si(Li) detector were used to deduce the subshell ionization cross sections: L_α components give L_{III} subshell ionization cross sections σ_{L3}, and L_γ components were computer analyzed into $L_{\gamma 5}$, $L_{\gamma 1}$, $L_{\gamma 2+3}$, and $L_{\gamma 4}$ to give the L_{II} and L_I subshell ionization cross sections, σ_{L2} and σ_{L1}, respectively. The data are compared with simple model calculations. The necessity of including some small but significant additional effects in the plane-wave Born-approximation treatment, particularly wave functions more realistic than the normally assumed hydrogenic forms, is discussed. (auth)

30868 MOLECULAR CHARGE TRANSFER. III. THE ROLE OF INCIDENT-ION VIBRATIONAL STATES IN H^+_2-H_2 AND D^+_2-D_2 COLLISIONS. Moran, T.F.; Flannery, M.R. (Georgia Institute of Technology, Atlanta, Georgia 30332); Albritton, D.L. J. Chem. Phys. 62: No. 7, 2869-2879 (1 Apr 1975).

Charge transfer cross sections for the H^+_2-H_2 and D^+_2-D_2 systems have been computed and compared with experimental measurements in the 1 eV to 5000 eV kinetic energy range. Cross sections have been calculated using a multistate impact parameter treatment of charge transfer in which the set of first-order coupled differential equations resulting from the time-dependent Schrödinger equation are solved numerically. At low kinetic energies the inclusion of a comparatively small number of product states results in converged cross sections. However, as the ion kinetic energy is increased, it becomes necessary to include as many as ~100 final vibrational states in the wavefunction expansion of the system. Both the energy defects and vibrational overlaps of the different product channels have a strong influence on reactions at low kinetic energies; but, as the ion energy is increased, the vibrational overlaps exert a relatively more important role in controlling the product state distribution. Vibrational overlaps have been computed using accurate wavefunctions which include the effects of vibration-rotation interaction. Variation of the theoretical cross sections with both ion kinetic energy and reactant ion vibrational state are in accord with experimental measurements. (auth)

30869 ON INFINITE ORDER SUDDEN APPROXIMATIONS FOR AN ARBITRARY POTENTIAL ENERGY. Hunter, L.W. (Applied Physics Laboratory, The Johns Hopkins University, Silver Spring, Maryland 20910). J. Chem. Phys. 62: No. 7, 2855-2859 (1 Apr 1975).

The infinite-order sudden approximation (IOSA) for rotational excitation, introduced by Pack and co-workers, is extended to arbitrary potential energies in an independent derivation of results also obtained by Secrest by another route. Close connections are established with the collision theory of Curtiss and co-workers. In addition, an IOSA for general rotating and vibrating molecules is presented. (auth)

30870 STUDIES OF INELASTIC MOLECULAR COLLISIONS USING IMPACT PARAMETER METHODS. II. EXACT AND HIGH-ENERGY APPROXIMATE CALCULATIONS. Fisanick-Englot, G.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 62: No. 7, 2747-2759 (1 Apr 1975).

Exact *quantum mechanical* impact parameter methods have recently been extended to include inelastic collisions through the use of an effective Hamiltonian. In this paper the nature of the impact parameter formulation will be explored through specific examples. First, we consider the case of a calculation for He-para-He_2 where the exact impact parameter amplitudes have been computed as a Neumann series of transition matrix elements obtained from an effective Hamiltonian close-coupling calculation. The purpose of this calculation is to provide a standard of functional behavior for comparison with amplitudes computed by approximate methods. Such approximate calculations were performed for Ar-TlF scattering using both exponential and fractional high-energy forms for the amplitudes. The two approximations are compared in detail, and it is found that the cross sections resulting from the exponential approximation show reasonable agreement with other calculations for the system using conventional (noneffective) close-coupling and various sudden approximations. Ranges of validity for the approximations are discussed, and general characteristics of the impact parameter amplitudes and the related cross section integrands are summarized. Comparison is also made with model system calculations discussed in a previous publication. A general procedure is presented for smoothing the highly oscillatory cross section integrands that commonly arise in exponential impact parameter treatments. (auth)

30871 INVERSION OF ORBITING SCATTERING FROM ELASTIC COLLISIONS OF REACTIVE MOLECULES. Anderson, R.W. (Division of Natural Sciences, University of California, Santa Cruz, California 95060); Herschbach, D.R. J. Chem. Phys. 62: No. 7, 2666-2677 (1 Apr 1975).

For elastic scattering produced by an attractive, spherically symmetric potential, the classical deflection angle is a single-valued function for impact parameters equal to or greater than that which gives orbiting at the centrifugal barrier. If reaction removes contributions from smaller impact parameters, the potential in this outer region can be derived from the elastic scattering by a simple inversion procedure. This is obtained by slightly modifying the Firsov method, so as to integrate from small angles inwards. Close to the centrifugal barrier, the scattering is determined primarily by the first and second derivatives of the potential, and an approximate inversion method for obtaining the derivatives is also given. These procedures are applied to data for nonreactive scattering of K atoms from Cl_2, Br_2, I_2, and ICl. The results indicate the orbiting model is a useful approximation for such reactions in the thermal range, although a less simple treatment is necessary at higher energies. The potential parameters obtained are discussed in terms of the "electron-jump" mechanism for these reactions and are related to other models and experiments. (auth)

30872 LOW ENERGY SCATTERING AND THE "FREE-FALL" ATOMIC MODEL. Gryziński, M. (Institute of Nuclear Research, Swierk k.Otowocka, Poland). J. Chem. Phys. 62: No. 7, 2629-2636 (1 Apr 1975).

The free-fall atomic model has been applied for quantitative analysis of atomic and molecular collision processes. The model yields results which are in agreement with the measurements. It describes properly the low-energy scattering of electrons (with respect to the energy dependence, as well as to the absolute cross section values) and van der Waals interaction and gives some insight into the nature of chemical bonds. The dynamic dipole was found to be a characteristic feature of π bonds. (auth)

30873 CLASSICAL THEORY OF ATOMIC COLLISIONS. II. LOW ENERGY SCATTERING. Gryziński, M. (Institute of Nuclear Research, Swierk k.Otwocka, Poland). J. Chem. Phys. 62: No. 7, 2620-2628 (1 Apr 1975).

It is shown that large number of low-energy scattering phenomena can be consistently explained if time-varying electric multipoles are ascribed to the atomic shell. Scattering experiments allow for estimation of the atomic multipoles and their absolute values and frequencies. It is discovered that atoms of the same chemical properties have multipoles of the same order, and only their absolute values and their frequencies are different. From the whole analysis the conclusion is drawn that unperturbed atomic field must be considered as nonspherical and dynamic in nature (nonstatic). (auth)

30874 COLLISIONS BETWEEN SYSTEMS OF COULOMB PARTICLES. I. SMALL-ANGLE SCATTERING FOR TIME-DEPENDENT FIELDS. Gryziński, M. (Institute of Nuclear Research,

Świerk k.Otwocka, Poland). J. Chem. Phys. 62: No. 7, 2610-2619 (1 Apr 1975).

Collisions between stationary systems of charged particles, i.e., systems in a dynamic equilibrium, are investigated in a so-called small-angle approximation. The interaction of unperturbed systems, described in terms of time-varying electric multipoles (with the dependence on time given by Fourier analysis) is discussed in detail. It is found that the exponential cutoff for the interaction is a characteristic feature of systems with fields periodically varying in time. Relations important for development of the low-energy atomic collision theory are derived. (auth)

30875 RADIATIVE LIFETIMES IN MOLECULES STUDIED BY MEANS OF FAST, MOLECULAR ION BEAMS. Jørgensen, S.W.; Sørensen, G. (Institute of Physics, University of Aarhus, DK-8000 Aarhus C, Denmark). J. Chem. Phys. 62: No. 7, 2550-2554 (1 Apr 1975).

Radiative lifetimes of excited levels in molecules have been studied by a spectroscopic investigation of the collision processes occurring between fast, molecular ion beams and helium atoms. This technique has been used to measure the lifetimes of the $A\ ^2\Delta$ state in CH, the $B\ ^2\Sigma^+$ state in CO^+, and the $B\ ^2\Sigma^+$ states in CO_2^+ with an accuracy of 10%–20%. A comparison with previously published results and a discussion on the perspectives of the method have been carried out. (auth)

30876 METASTABLE FRACTIONS OF FAST He ATOMS PRODUCED BY ELECTRON DETACHMENT FROM He^- IONS. Pedersen, E.H.; Simpson, F.R.; Hvelplund, P. (Institute of Physics, University of Aarhus, DK-8000 Aarhus C, Denmark). Phys. Rev. A 11: No. 2, 516-521 (Feb 1975).

The metastable fraction of He atoms produced by electron detachment from He^- ions in single collisions with H_2, He, N_2, Ne, and Ar has been measured in the energy range 25–400 keV by the beam–attenuation technique, using H_2 as attenuation gas. These data support earlier results, pointing to the existence of a bound, long-lived doublet state of He^-. Further, the electron loss and deexcitation cross sections for metastable He atoms in He, N_2, Ne, and Ar have been measured individually at 50 keV, and it is shown that the deexcitation cross section is comparable to the electron–loss cross section. (auth)

30877 PRODUCTION OF D* ($n = 4$) FROM ELECTRON–D_2^+ DISSOCIATIVE RECOMBINATION. Phaneuf, R.A.; Crandall, D.H.; Dunn, G.H. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). Phys. Rev. A 11: No. 2, 528-535 (Feb 1975).

Crossed beams of electrons and D_2^+ ions were used to measure absolute cross sections for the dissociative recombination process, $e + D_2^+(X\ ^2\Sigma_g^+) \rightarrow D + D^*$ ($n = 4$) over a range of electron energies extending from 0.6 to 7 eV. The process was monitored by detecting a known portion of the 485.9–nm emission resulting from radiative decay of the product D* ($n = 4$) atoms. The cross sections, which correspond to a known vibrational–state distribution of the target ions, exhibit the same dependence on electron energy as recent measurements of the total dissociative recombination cross section reported by Peart and Dolder, and have a magnitude of about 10% of the total cross section, suggesting that the product D atoms are formed in excited states with a variety of principal quantum numbers. Systematic measurement uncertainties at high confidence are about 14%, and random uncertainties are at the 25% (S.D.) level. The calculation of cross sections from the observed light intensities depends on the mean lifetimes and branch ratios for 485.9–nm emission, whose evaluation in turn requires assumptions concerning the recombination process. The situation is complicated by the presence of an electron–beam–confining magnetic field in the collision volume, which causes the incident ions and product atoms to experience a transverse motional electric field. A time–independent perturbation calculation of the weak–field Stark and Zeeman effects was performed, and mean lifetimes and branch ratios were estimated under different assumptions concerning the recombination process. Assuming that all perturbed product $n = 4$ states are equally populated by dissociative recombination yields an experimental cross section of 1×10^{-16} cm^2 at 0.7 eV, decreasing to 3.3×10^{-17} cm^2 at 3 eV, and to 1×10^{-17} cm^2 at 7 eV. Assuming that only the perturbed 4*s* states are initially populated results in cross sections larger by some 50%. (auth)

30878 QUANTUM MECHANICAL REACTION CROSS SECTIONS FOR THE THREE–DIMENSIONAL HYDROGEN EXCHANGE REACTION. Elkowitz, A.B. (Department of Physics, University of Texas, Austin, Texas 78712); Wyatt, R.E. J. Chem. Phys. 62: No. 6, 2504-2506 (15 Mar 1975).

The results of extensive multi–channel quantum mechanical studies of the three dimensional hydrogen exchange reaction are reported. Reaction cross sections were obtained for both the Porter–Karplus potential surface (collinear barrier height 0.396 eV) and the Yates–Lester–Liu surface (collinear barrier 0.424 eV). (AIP)

30879 QUANTUM MECHANICAL REACTIVE SCATTERING: AN ACCURATE THREE–DIMENSIONAL CALCULATION. Kuppermann, A.; Schatz, G.C. (A. A. Noyes Laboratory of Chemical Physics, Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, California 91125). J. Chem. Phys. 62: No. 6, 2502-2504 (15 Mar 1975).

Accurate three–dimensional (3–D) quantum–mechanical calculations of differential and total cross sections for the $H + H_2$ exchange reaction on the Porter and Karplus potential energy surface have been performed. These are the first such calculations which are vibrationally and rotationally converged, and the results are believed to be accurate to 5% or better. They can serve as a comparison standard against which approximate methods can be tested. (AIP)

30880 SCATTERING OF LIGHT BY A METASTABLE LEVEL OF THE HYDROGEN MOLECULE. Davydkin, V.A.; Rapoport, L.P. (Lenin Komsomol State University). Sov. J. Quantum Electron. 4: No. 9, 1123-1127 (Mar 1975).

An analysis is made of the Rayleigh and Raman vibrational scattering of light by the $c^3\Pi_u$ metastable level of the H_2 molecule. The polarizability of metastable H_2, HD, and D_2 molecules is analyzed to demonstrate the influence of the nuclear motion on processes which are of the second order in the perturbation theory. The quantum defect approximation and a spheroidal system of coordinates, which makes it possible to allow for the nonsphericity of the molecular fields, is used in the derivation of the optical–electron Green's function and of the electronic wave functions. Calculations are made of the polarizability, its derivative with respect to the separation between the nuclei in the molecule, and degree of depolarization in the Rayleigh and Raman scattering of ruby and neodymium laser radiation. (auth)

30881 A COLLISION CROSS SECTION STUDY OF THE $1\ ^1S \rightarrow 2\ ^1P$ AND $1\ ^1S \rightarrow 2\ ^1S$ TRANSITIONS IN HELIUM AT KINETIC ENERGIES FROM 200–700 eV. FAILURE OF THE BORN APPROXIMATION AT LARGE MOMENTUM CHANGES. Dillon, M.A.; Lassettre, E.N. (Department of Chemistry, Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 62: No. 6, 2373-2390 (15 Mar 1975).

Differential collision cross sections have been determined for the $1\ ^1S \rightarrow 2\ ^1S$ and $1\ ^1S \rightarrow 2\ ^1P$ transitions in helium at scattering angles within the range 7.5°–35° and kinetic energies of 200, 300, 400, 500, and 700 eV. Multiple scattering errors have been eliminated by determining the ratio of inelastic to elastic cross section as a function of pressure (the dependence is linear) and extrapolating to zero pressure. The error in the absolute cross sections is less than 5% in most instances. Where large corrections for multiple scattering are necessary, the error bound is 6%. Generalized oscillator strengths (f) have been calculated from the data for both transitions and compared with the Born approximation calculations (f_B) of Kim and Inokuti [Phys. Rev. 175, 176 (1968)]. At a scattering angle of 30° the ratio f_B/f (which would be unity if the Born approximation were accurate) decreases from the value 0.86 at 200 eV to 0.16 at 500 eV for the transition $1\ ^1S \rightarrow 2\ ^1P$. At smaller values of the squared momentum change (between 0.5 and 2.5 a.u.) deviations from the Born approximation are still significant (about twice our experimental error), and approach to the Born limit is very slow, imperceptible, in fact, from 300 to 700 eV. Despite the poor agreement between the *differential* cross sections measured by us and those calculated from the Born approximation, we have found excellent agreement between the *integrated* (over angle) cross sections calculated from our measurements and those obtained from the Born approximation (with a small correction for exchange). The reasons for the above observations are discussed, where feasible, and comparisons are made with the experimental and theoretical results of other investigators. (auth)

30882 ROTATIONAL EXCITATION IN H_2–H_2 COLLISIONS: CLOSE–COUPLING CALCULATIONS. Green, S. (Goddard Institute for Space Studies, 2880 Broadway, New York, New York 10025). J. Chem. Phys. 62: No. 6, 2271-2277 (15 Mar 1975).

Rotational excitation in molecule–molecule collisions has been treated for the first time by accurate quantum close–coupling scattering calculations, employing an expansion basis set of two to three rotational levels for each molecule and correctly accounting for exchange of identical particles. Elastic and inelastic cross sections have been computed for collisions of para–para, ortho–ortho, and para–ortho hydrogen molecules assuming an intermolecular potential suggested previously. The accuracy of recent "effective potential" calculations is demonstrated by comparison with the exact quantum results. (auth)

30883 ELECTRON LOSS CROSS SECTIONS FOR O^-, O^-_2, NO^-_2, AND NO^-_3 IN SEVERAL GASES. Bennett, R.A.; Moseley, J.T.; Peterson, J.R. (Stanford Research Institute, Menlo Park, California 94025). J. Chem. Phys. 62: No. 6, 2223-2227 (15 Mar 1975).

The cross sections for electron loss for O^-, O^-_2, NO^-_2, and NO^-_3 on He, N_2, and Ar, for O^- on O_2, and NO^-_3 on NO_2 have been

measured using a beam attenuation technique. The measured cross sections are the sum of collisional detachment and electron transfer cross sections. Except for $O^- + O_2$, the cross sections are nearly constant for ion energies in the range 1 to 4 keV and generally increase with target mass. (auth)

30884 COULOMB EFFECTS AND VRIENS' APPROACH. Narain, U.; Chandra, S. (Atomic and Molecular Physics Research Group, Physics Department, Meerut College, Meerut-250001, India). Phys. Lett., A; 50: No. 5, 355-356(30 Dec 1974).

The electron detachment cross sections of a few negative alkali ions have been investigated semi-empirically. It is shown that the inclusion of Coulomb repulsion significantly affects the cross sections at low energies. (auth)

30885 MAGNETIC FIELD DEPENDENCE OF THE COLLISION TRANSFER RATE BETWEEN M-SUBLEVELS. Fuchs, B.; Hanle, W.; Oberheim, W.; Scharmann, A. (Giessen Univ. (F. R. Germany). 1. Physikalisches Inst.). Phys. Lett., A; 50: No. 5, 337-338(30 Dec 1974).

The magnetic field dependence of Hg^* (m = 0) + Xe → Hg^* (m = ±1) + Xe collisions in the range from 0 to 15 has been measured. Additional magnetic field dependent effects were found. (auth)

30886 EXCITATION OF H_2 AND D_2 BY ELECTRON SCATTERING NEAR THE IONIZATION THRESHOLD. Roy, D.; Carette, J. D. (Univ., Laval, Quebec). Can. J. Phys.; 53: No. 2, 175-183(15 Jan 1975). (In French).

Results about energy losses of slow electrons (~100 eV) which are scattered in the forward direction by molecular hydrogen and deuterium. The region near the ionization threshold were investigated with great care in order to determine the contribution of electronic states B′, D, B″, D′, and D″ to the excitation of these molecules through this channel, and also to determine if this scattering channel allows one to obtain evidence of direct ionization and autoionization. (auth)

30887 DETERMINATION OF POSITRONIUM–ATOM COLLISION CROSS SECTION. Spektor, D. M.; Paul, D. A. L. (Univ. of Toronto). Can. J. Phys.; 53: No. 1, 13-22(1 Jan 1975).

The collision cross section of positronium in He, Ne, Ar, Kr, Xe, N_2, and isobutane gases at thermal energies by studying the diffusion of positronium to the walls of a specially designed chamber. The time distribution of annihilations is measured as a function of pressure for each gas. The presence of an admixture of 20 Torr of isobutane in the chamber quenches the free positron component so that the orthopositronium component is the only exponential decay in the time spectrum of annihilations. Diffusion theory is used to obtain theoretical values of the orthopositronium decay constant λ_2. These values are a function of three parameters, two of which are common to all results; the third one is σ_c, the collision cross section. Monte Carlo simulations of the isobutane experiments verify the theoretical results and determine the wall annihilation parameter which is common to all experiments. The Monte Carlo calculations also enable the determination of the second parameter common to all the experiments, which occurs in a correction term in the diffusion theory. The entire analysis was carried out twice, one in each of the following extreme cases: (1) assuming that no triplet to singlet conversion takes place at the walls of the cells, and (2) assuming that the maximum conversion takes place at the walls. The cross sections in case (1) are, in units of πa_0^2: He, 0.0166 ± 0.0017; Ne, 0.042 ± 0.003; Ar, 0.086 ± 0.005; Kr, 0.099 ± 0.006; Xe, 0.128 ± 0.008; N_2, 0.238 ± 0.014; and isobutane, 0.534 ± 0.016. The implications for other types of experiment and theory are briefly discussed, in particular the bubble model for positronium in liquids. (auth)

30888 NEW METHOD OF INVESTIGATING THE ELECTRONIC AND ION–ATOMIC MECHANISMS OF STOPPING HEAVY IONS IN MATTER. Lemberg, I. Kh.; Pasternak, A. A. (Ioffe Inst. of Physics and Tech., Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 12, 401-402(20 Jun 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 12, 784-787(20 Jun 1974).

It is shown that the use of a semithick target in experiments on Coulomb excitation of nuclei makes it possible to investigate the stopping of the recoil nuclei in matter, by analyzing the shape of the γ line that is Doppler broadened by deexcitation of the excited recoil nuclei emitted into vacuum. (auth)

30889 SPECTROSCOPY OF MOLECULAR X-RAY EMISSION IN HEAVY ION SCATTERING (A NEW KIND OF X-RAYS). Saris, F. W. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Atomkernenergie; 24: No. 2, 73-78(1974). (In German).

Besides electrons, which were used by W. C. Roentgen, also ions can be employed for the production of x-rays. During ion–atom collisions the atomic inner-shells get readily excited and start to emit x-rays that are characteristic for the colliding particles. For two reasons these characteristic x-rays are important. First, the intensity is very high and the background radiation so low that ion-induced x-ray emission is one of the most sensitive analytical techniques. An example of an air pollution study is given. Secondly, the study of the mechanism of characteristic x-ray production has revealed a series of new physical phenomena. (auth)

30890 THEORETICAL TREATMENT OF QUENCHING IN $O(^1D) + N_2$ COLLISIONS. Zahr, G. E.; Preston, R. K.; Miller, W. H. (Lawrence Berkeley Lab., CA). J. Chem. Phys.; 62: No. 3, 1127-1135(1 Feb 1975).

It is maintained that quenching of $O(^1D)$ by collision with N_2 proceeds by formation of a collision complex on the lowest singlet potential surface. Once a collision complex is formed, even the weak spin–orbit interaction in O atom can induce quenching with essentially unit probability (at thermal energies) because the intersection of the singlet $[O(^1D) + N_2]$ and triplet $[O(^3P) + N_2]$ potential surfaces is crossed many times during the life of the complex. Rather crude, but qualitatively reasonable, potential surfaces for $O(^1D) + N_2$ are constructed, and classical trajectory calculations carried out to show that the cross section for complex formation is indeed appreciable, ~40 Å^2 at thermal energy; a statistical model is used to determine the quenching probability of the collision complex. Values obtained for the magnitude of the thermal rate constant for quenching and the fraction of the exoergicity which appears as vibrational excitation of N_2 are both in good agreement with experimental results. (3 figures, 2 tables) (auth)

30891 NOTE ON THE IMPACT PARAMETER TREATMENT OF EXCITATION AND IONIZATION BY H^+. Kocbach, L. (Univ. of Bergen). J. Phys., B (London); 7: No. 17, L486-L488(1 Dec 1974).

The equivalence of two theoretical approaches is shown and the advantages of a common formulation are discussed. (auth)

30892 Ne K AUGER CROSS SECTIONS FROM 1.5 MeV/amu H, O, AND F. Woods, C. W.; Kauffman, R. L.; Jamison, K. A.; Cocke, C. L.; Richard, P. (Kansas State Univ., Manhattan). J. Phys., B (London); 7: No. 17, L474-L477(1 Dec 1974).

Ne K-shell Auger electron production cross section, σ_A, have been measured for Ne bombarded by 1.5 MeV/amu H, O, and F. σ_A is found to increase with increasing projectile charge state which is a clear indication that the K-shell vacancy production cross section, σ, is increasing with increasing projectile charge state since the fluorescence yield, ω, is increasing with increasing charge state and since $\sigma = \sigma_A/(1-\omega)$. The cross sections are compared to Coulomb ionization predictions. (auth)

30893 ELASTIC SCATTERING OF FAST ELECTRONS BY ATOMS. I. Helium to Neon. Inokuti, M.; McCowell, M. R. C. (Argonne National Lab., IL). J. Phys., B. (London); 7: No. 17, 2382-2395(1 Dec 1974).

The total elastic-scattering cross section for electrons on neutral atoms is evaluated in the first Born approximation via tabulated values of the form factors. The cross section at energy k^2 rydbergs is expressed as $\Sigma_{l=1}^{3} a_l(Z)k^{-2}$ values of the coefficients $a_l(Z)$ being given for $1 < Z < 10$. The theoretical results are compared with experiment for helium, neon and lithium. For lithium, comparisons are also made with Glauber and polarized-Glauber models. A simple model is presented for low-energy total cross sections in lithium, and its predictions compared with experiment. Elastic differential cross sections for helium and neon are briefly discussed. (auth)

30894 GENERALIZED RANDOM PHASE APPROXIMATION, AS A COUPLED CHANNEL PROBLEM. Csanak, G. (Jet Propulsion Lab., Pasadena, CA). J. Phys., B (London); 7: No. 17, L478-L482(1 Dec 1974).

It is shown that the generalized random phase approximation of elastic scattering can be formulated as a coupled channel problem. Its relationship to the many-channel scheme, the close-coupled equations and the first-order many-body theory for inelastic scattering is also discussed. (auth)

30895 RELATIONSHIP BETWEEN THE MANY-BODY THEORY OF INELASTIC SCATTERING AND THE DISTORTED WAVE APPROXIMATION. Rescigno, T. N.; McCurdy, C. W.; McKoy, V. (California Inst. of Tech., Pasadena). J. Phys., B (London); 7: No. 17, 2396-2402(1 Dec 1974).

It is shown that the first-order results of the many-body theory of inelastic electron scattering (Csanak, Taylor and Yaris. Phys.

Rev.; A3: 1322-8 (1971)) can be derived quite simply by a direct application of the distorted-wave and random phase approximations to the usual expression for the inelastic scattering amplitude. The result is derived both in the second quantized formalism and by the standard application of the distorted-wave approximation coupled with the random phase approximation (RPA). The RPA (or time-dependent Hartree-Fock theory) just provides the transition density between the initial and inelastically excited states. Possible generalizations of the procedures are discussed. (auth)

Atomic Theory

Refer also to abstract 31692.

30896 OSNOVY FIZIKI. Tom 2. Kolebaniya i Volny; Osnovy Kvantovoi Fiziki Atomov, Molekul i Tverdykh Tel; Fizika Yadra i Elementarnykh Chastits. (Principles of Physics. Volume 2. Oscillations and Waves; Principles of Quantum Physics of Atoms, Molecules, and Solids; Physics of the Nucleus and Elementary Particles). Yavorskii, B. M.; Pinskii, A. A. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1974). 464p.

Oscillation and wave processes (including optics) and contemporary concepts on the physics of atoms, molecules, and solids and on their most important properties are examined. The treatment is inherently related with the theory of relativity and quantum mechanics. (tr-auth)

30897 RADIATIVE AND RELAXATION EFFECTS ON LINE SHAPE. Di Giacomo, A. (Scuola Normale Superiore, Pisa, Italy); Feo, F. Nuovo Cim., B; 25B: No. 2, 730-738(11 Feb 1975).

The quantized-field formalism for computing nonlinear responses to electromagnetic excitations is combined with the Liouville-operator formalism. The result is a simple and clear treatment of relaxation which greatly simplifies otherwise complicated problems. (auth)

30898 EFFECT OF THE CHEMICAL ENVIRONMENT OF AN ATOM ON THE TOTAL DENSITY OF ITS ELECTRONS IN THE REGION OF THE NUCLEUS. Kadykenov, M. M. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 75-76(1974). (In Russian).

Experimental methods for the study of the density of the orbital electrons in the region of the nucleus, necessary for the interpretation of the isomeric displacement of the Moessbauer spectra, were examined. The simultaneous use of experiments on electron capture and internal electron conversion was proposed for this purpose. (tr-auth)

30899 A TIME-DEPENDENT VARIATION-PERTURBATION METHOD FOR THE CALCULATION OF TRANSITION PROPERTIES AND ITS RELATION TO THE RANDOM PHASE APPROXIMATION. Huo, W.M. (Department of Chemistry, Mellon Institute of Science, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 62: No. 6, 2072-2086 (15 Mar 1975).

A time-dependent variation-perturbation (VP) formulation is presented for the simultaneous calculation of the ground-state correlation function and the excited-state wavefunction of an atomic or molecular system. The wave functions are chosen for the optimal calculation of transition properties with a relatively small number of molecular integrals. The VP equations so obtained for a singlet system are identical with the equations in the random phase approximation (RPA). On the other hand, if the ground state is a singlet and the excited state a triplet, the VP and RPA equations are different. The latter assumes a ground-state correlation function with an open-shell component, which is a poor approximation for a closed-shell ground state. The orthonormalization condition in the VP scheme is different from that in the RPA. The consequence of this difference is discussed. It is also pointed out that the RPA excitation energy actually contains part of the ground-state correlation energy; hence the RPA excitation energy is always lower than the corresponding values in the Tamm-Dancoff approximation and the self-consistent RPA. A variational formulation of the time-dependent problem gives a set of equations which resembles the higher RPA equations. (auth)

30900 PERTURBATION THEORY FOR SHORT-RANGE ATOMIC INTERACTIONS. II. THE RADIUS OF CONVERGENCE. Certain, P.R.; Merkel, R.R. (Department of Chemistry and Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 62: No. 6, 2406-2410 (15 Mar 1975).

The perturbation energy series of Byers Brown and Power, applied to the case of one-electron diatomics, is analyzed for various internuclear separations to obtain the radius of convergence. The convergence of the series is limited by a branch point on the real axis for nonphysical values of the perturbation parameter. (auth)

30901 PHYSIQUE GENERALE ET EXPERIMENTALE. Atomes, Molecules, Particules. (Fundamental and Experimental Physics: Atoms, Molecules, Particles). Fleury, P.; Mathieu, J. P. Paris, France; Eyrolles (1974). 387p. (In French).

Results obtained in electricity and optics are reviewed, their interpretation sometimes involving particle movements and sometimes wave transmission of energy. The basic principles of wave mechanics are outlined in order to reach a satisfactory representation of the structure of atoms, molecules, liquids and crystals while giving a coherent explanation of quantum rules already known. The more directly approachable study of radiations and transformations of radioactive substances leads to that of artificial transmutations, cosmic rays and particle accelerators, then to information on the make-up of nuclei, the forces they enclose and the use of nuclear energy. (FR)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

30902 (IPF-73-5) EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF MAGNETOHYDRODYNAMIC FLOW PROCESSES WITH TRANSVERSE MAGNETIC FIELD IN THE SHOCK TUBE. Holzhauer, E. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Plasmaforschung). 1973. 97p. (In German). INIS.

The interaction between a flowing plasma and a finite transverse magnetic field in flow direction, which has become known as the end effect in MHD energy converters, is investigated experimentally and numerically. The instationary plasma flow is produced in a gas dynamic shock tube at shock mach numbers between 9 and 13 and initial pressures between 1 and 10 torr in an argon-xenon mixture with short ionization relaxation time. The channel walls are dielectric so that the ends of all currents induced in the gradient zones meet in the plasma. The following plasma parameters are measured: gas pressure (piezoelectric pressure probes), magnetic field (inductive probes), induced EMK (potential probes), electron density variation (continuum radiation) and gas density (interferometer). The MHD equations are discussed for the case of two-dimensional flow with transverse magnetic field. Using the propagation of longitudinal MHD waves (magnetoacoustic waves) as an example, the influence of the finite electric conductivity of the plasma on the dispersion equation can be derived from the linearized equations. The numerical calculation of the instationary, two-dimensional MHD equations is done by means of the Lax-Wendroff difference method assuming equilibrium ionization. The interaction experiment is characterized by the following effects: (1) Due to the plasma flow passing the two magnetic field gradients, eddy currents are induced in the plasma, reducing the ultrasonic flow to subsonic flow. In addition the transverse components of the Lorentz force lead to the formation of pressure gradients over the entire channel cross section. There are no collision discontinuities in the conductive plasma plug. (2) Modification of the rarefaction and compression waves in the homogeneous region of the magnetic field and (3) the course of the interaction is strongly determined by ionization effects. (auth)

30903 (UCRL-51715) MAGNETOHYDRODYNAMICS OF HEMP. Wilkins, M. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1973. Contract W-7405-Eng-48. 55p. Dep. NTIS $5.45.

Using the continuum mechanics approach, details are presented for solving the equations of magnetohydrodynamics in two space dimensions and time. The problem considers cylindrical symmetry, in that only the H_θ component of a magnetic field is present. The problem is formulated so that the stress contributions resulting from a magnetic field are incorporated into the stress tensor as an elastic-plastic computer program. In addition to the Lorentz force and magnetic diffusion, thermal and radiation diffusion are also treated. (auth)

30904 HOMOGENEOUS AND HETEROGENEOUS REACTIONS ON THE DISPERSION OF A SOLUTE IN MAGNETOHYDRODYNAMIC LAMINAR FLOW. Narasimha Murthy, S.; Krishna Murthy, M. R. (Univ. of Agricultural Sciences, Bangalore, India). Indian J. Phys.; 48: No. 7, 634-640(Jul 1974).

The effects of homogeneous and heterogeneous reactions on the dispersion of a solute in a magnatohydrodynamic laminar flow between two plates is discussed. In the case of diffusion with a homogeneous first order reaction, it is found that the effective dispersion coefficient decreases with the increase in the reaction rate together with the Hartmann Number. In the case of diffusion combined with the homogeneous and heterogeneous chemical reactions, the increase in the wall catalytic parameter together with the Hartmann number also causes a decrease in the effective Taylor dispersion coefficient. The above analysis suggests that a solute in an electrically conducting solvent can regulate rate of diffusion. (auth)

30905 MOTION OF MAGNETIZED CONDUCTING LIQUID BETWEEN TWO FLAT ELECTRODES IN A TRANSVERSE MAGNETIC FIELD. Tarapov, I. E. Fluid Dyn. (USSR) (Engl. Transl.); 7: No. 6, 1031-1035(1972).

Translated from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Goza; 7: No. 6, 179-184(1972).

A theoretical study of media that are polarized in an electromagnetic field is presented. A stationary plane, the motion of a viscous conducting liquid between two plate electrodes in a constant magnetic field is considered. It is assumed that the isotropic magnetizable liquid is in the state of magnetic saturation. It is noted that the assumption that the magnetization is proportional to its density makes it possible to take into account the magnetostriction stresses. Edge effects are neglected. (MHR)

30906 CASE WHEN THE CONDUCTION CURRENT CANNOT BE ZERO IN GENERAL RELATIVISTIC MAGNETOHYDRODYNAMICS. Ciubotariu, C. D. (Institutul Politehnic, Jassy, Romania). J. Phys., A (London); 8: No. 2, 283-284(Feb 1975).

It is pointed out, in connection with infinite conductivity in general relativistic magnetohydrodynamics, that in a region where the magnetic field lines are orthogonal to the vorticity vector there must be a nonzero conduction current. It is also shown that the relation $2\omega H = \epsilon$ derived by Yodzis (Phys. Rev. D.; 3: 2941-5(1971)) assuming infinite conductivity, is also valid when the electric field vector satisfies Killing's equations. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 31332.

30907 (COO-2232A-17) EXPERIMENTAL STUDIES OF ELEMENTARY PARTICLE INTERACTIONS AT HIGH ENERGIES. Technical Progress Report. Cool, R. L. (Rockefeller Univ., New York (USA)). Jan 1975. Contract AT(11-1)-2232. 19p. Dep. NTIS $4.00.

Experimental research in high energy physics is summarized. A list of publications is included. (JFP)

30908 SEARCH FOR HIGHLY CHARGED PARTICLES IN COSMIC RAYS. Yock, P. C. M. (Auckland Univ. (New Zealand). Dept. of Physics). Nucl. Phys., B; 86: No. 2, 216-220(10 Feb 1975).

The recently obtained results on e^+e^- → hadrons and multigamma production in pp collisions provide some support for a previously made argument that heavy, highly charged subnucleons may exist, and a search for such particles in cosmic rays has been made. In 620 hours no candidates were detected, and an upper limit for the unaccompanied particle flux of $7 \cdot 10^{-10}$ cm^{-2} sec^{-1} sr^{-1} at sea level under 600 g/cm^2 concrete is obtained with 90% confidence. (auth)

30909 HIGH ENERGY PHYSICS FILE 1. Physics Flowers but Funds Wither; and the Current State of Particle Physics. Walgate, R.; Weinberg, S. New Sci.; 65: No. 938, 496-499(25 Feb 1975).

The present contradictory position of high energy physicists, in many countries, is considered. Although those who study subatomic particles are enjoying the most creative period in their subject for many decades yet their projects are the subject of drastic cutback of funds from their respective governments. Unfortunately this could not be at a worse moment to stop research in HEP since there is at present a great excitement as new theory and new experiments which mostly involve the interaction of leptons with hadrons, are being considered. An attempt is made to assess the impact HEP has had on other sciences and on the public as a whole. The various "tribes" of the HEP community are considered; the inventors of the experimental equipment, the experimenters, the phenomenologists and the theorists. A short note on the current state of particle physics with especial reference to the unified gauge theory of the weak and electromagnetic interactions is given. (UK)

30910 TWO PARTICLES THAT TROUBLE PHYSICISTS. de Closets, F. Sci. Avenir; No. 335, 16-21(Jan 1975). (In French).

The discovery of the two new particles psi at 3,105 and 3,700 MeV and the difficulties they create for quark theory are discussed. (FR)

Electromagnetic

Refer also to abstract 29750.

30911 (DESY-74/61) ELECTROPRODUCTION OF η MESONS IN THE REGION OF THE RESONANCE $S_{11}(1535)$. Alder, J. C.; Brasse, F. W.; Fehrenbach, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Jan 1975. 23p. Dep. NTIS (US Sales Only) $4.25.

An experiment is reported on electroproduction in the resonance region in the mass range $1505 \leq W \leq 1715$ MeV. Data were taken at $q^2 = 0.22$, 0.6 and 1 GeV^2. The obtained angular distributions support the idea that η production proceeds mainly through S-wave excitation due to the resonance $S_{11}(1535)$. The total cross section of the formation of this resonance decreases much more slowly with increasing momentum transfer than the total ep cross section. (auth)

30912 (ORO-2504-227) ELECTRON-POSITRON INCLUSIVE HADRON REACTIONS. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1974. 15p. (CONF-750110-1). Dep. NTIS $4.00.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

Some of the preliminary results of an experiment to study e^+e^- interactions at a colliding beam facility are given on the inclusive cross sections. (JFP)

30913 (UCRL-Trans-10827) COINCIDENCE MEASUREMENT OF THE ELEMENTARY PROCESS OF ELECTRON-ELECTRON BREMSSTRAHLUNG AT 300 keV. Nakel, W.; Pankau, E. Translated from Z. Phys.; 264: 139-153(1973). 25p. Dep. NTIS $4.25.

The absolute cross section of electron-electron bremsstrahlung which is differential in all the free kinematical variables was measured by using an electron-photon coincidence technique. An electron beam of 300 keV was used, incident on a carbon target. Within the experimental errors agreement was found with recent theoretical calculations. Simultaneously with the electron-electron bremsstrahlung the absolute cross section of electron-nucleus bremsstrahlung of carbon was measured. (auth)

30914 FURTHER LIMITS ON THE STABILITY AGAINST ELASTIC TACHYONIC DECAY. Ljubičić, A.; Pavlović, Z.; Pisk, K. (Institute Rudjer Bošković, Zagreb, Yugoslavia); Logan, B.A. Phys. Rev. D 11: No. 3, 696-697 (1 Feb 1975).

An experimental arrangement involving a metal oxide cathode and a windowless-channel electron multiplier has been used to place a lower limit on the lifetime of elastic tachyonic decay. Our system was sensitive to tachyons with proper masses greater than 1.1 keV and we obtain a lower limit of 4.6×10^{13} years for the mean life. The result gives a lower limit for the lifetime, in the tachyon proper-mass range of about 1-10 keV, which is higher than that obtained previously. (auth)

30915 INCLUSIVE CROSS SECTIONS FOR PION AND PROTON PRODUCTION BY PHOTONS USING COLLIMATED COHERENT BREMSSTRAHLUNG. Kaune, W.; Miller, G.; Oliver, W.; Williams, R.W.; Young, K.K. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. D 11: No. 3, 478-494 (1 Feb 1975).

Cross sections for the inclusive processes $\gamma p \rightarrow \pi^+ X$ and pX have been measured at the Stanford Linear Accelerator Center for linearly polarized photons of average energy 10 and 14 GeV. The kinematic range of detected particles was $P_T = 0.15$ to 1.0 GeV/c, x from 0 to -0.32 for pions and -0.3 to -0.8 for protons at 10 GeV; the 14-GeV data had measurements at $x = 0$ for pions and $x \approx -0.3$ for protons. The experiment was carried out using collimated coherent bremsstrahlung from a thin diamond radiator and the SLAC 1.6-GeV/c spectrometer. The variation of the cross section, as a function of x and P_T, shows a marked similarity to that observed for pion and proton production from pp collisions. Our results show little dependence of the pion invariant cross section on either energy or polarization. The π^+/π^- ratio varies from 1.3 at $x = 0$ to 1.75 at $x = -0.32$. (auth)

30916 RECENT EXPERIMENTAL RESULTS. Strauch, K. (Cambridge Electron Accelerator, Mass. (USA)). pp 1-24 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 42 refs.

New experimental results in the field of electron-positron colliding beam physics which have become available since the 1971 Cornell Conference are summarized. Particular stress is made on those results submitted to this conference. The three reactions of order α^2 for the study of the validity of quantum electrodynamics with e^+e^- colliding beams are discussed. Results on the validity of QED and on the search for heavy leptons from studies of the α^3 order Bremsstrahlung reaction are discussed as are three QED reactions of order α^4. Recent experiments on hadron pair production are reported briefly and new investigations of multihadron production are discussed. (BRH)

30917 THEORY OF INCLUSIVE PROCESSES. Rubinstein, H. R. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics). pp 285-298 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds).. Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 80 refs.

Duality is discussed in terms of the phenomenology of deep inelastic scattering as a function of ω. Phenomenological duality works very well for virtual Compton scattering, both for neutrons and protons. Resonances survive the high q^2 regime, but there is background as well that contributes only to $I = 0$ t-channel amplitudes. The relative importance of $I = 1$ and $I = 0$ contributions as a function of q^2 is unknown. Deep inelastic scattering in a model

with constituent and current quarks is discussed. It is shown that there is little support in the present energy and q^2 regime for parton model predictions. Nevertheless, some results may be more general and of fundamental validity, for example Drell-Yan threshold relations and μ-pair scaling laws. Models for scaling breakdown including field theory calculations of anomalous dimensions and a Thirring model as a conformal bootstrap are discussed. (BRH)

30918 TOTAL CROSS SECTIONS. Gabathuler, E. (Science Research Council, Daresbury, Eng.). pp 299-312 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27 –31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 27 refs.

The measurement of total hadronic cross sections produced by real and virtual photons is a relatively new field of physics as the results of the first measurements were presented at the Liverpool Conference (1969). Since that time, the main features of the total cross sections in H_2 and D_2 have been established showing a fairly rapid transition from the resonance region to the high-energy "Regge" region at a photon energy around 3 GeV. In addition the absorption of real and virtual photons in nuclear matter has raised some interesting questions, which have not yet been resolved. In this report, new results on total cross sections and related topics which have appeared since the Cornell conference (1971) are considered. (auth)

30919 PARTICLE PRODUCTION. Brasse, F. W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). pp 251-283 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27 –31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 59 refs.

Experiments on inclusive photo- and electroproduction have been carried out at many laboratories. It is shown how the various measurements are distributed in the plane of q^2 and s. In the direction of increasing q^2 for fixed energy the following large changes between $q^2 = 0$ and $q^2 = 1$ GeV^2 are seen. (1) $\langle n \rangle$ decreases; $\sigma(1\text{-prong})/\sigma_{tot}$ increases, (2) π^+,π^- rates decrease for $\chi > 0.3$, (3) $p_\perp$ distributions for π^+, π^- become flatter for $\chi > 0$, correspondingly $\langle p_\perp \rangle$ for protons increases for $\chi < 0$, (4) K^+/π^+ ratio increases; but $f_\chi^\pm/\sigma_{tot}$ does not increase with q^2. The vanishing contribution from the ρ^0 is responsible for a large part of the effects. Furthermore increasing $|t|_{min}$ and probably also the appearance of longitudinal parts of the cross section are important. For σ_{tot} the above results mean, that diffractive channels disappear and nondiffractive ones, especially 1-prong on proton target, are relatively more important. This is not surprising, since one is entering the region ω' less than 10, where there are already indications of increasingly nondiffractive behavior from the difference between the neutron and proton structure functions. Above $q^2 = 1$ GeV^2 one does not see in the covered energy range any further strong changes. It is remarkable that Bjorken scaling of the structure function νW_2 in ω starts at the value of q^2, where the inclusive hadron distributions become less dependent on q^2. Also for $q^2 > 1$ GeV^2 the total cross section is almost completely built up by the particles produced in the central region, whereas for $q^2 < 1$ GeV^2 the relative part to the total cross section coming from χ greater than roughly 0.5 is much larger. Therefore Bjorken scaling is mainly built up by the central region. In the direction of increasing s one sees: (1) $\langle n \rangle$ increases like ln s; higher prongs increase. (2) π^+, π^- distributions increase with s around $\chi = 0$ for small $p_\perp$ as well as for large $p_\perp$, (3) At large values of $|\chi|$ the distributions show energy behavior similar to the corresponding exclusive channels. (auth)

30920 TWO-BODY AND QUASI-TWO-BODY PRODUCTION OF PSEUDOSCALAR AND VECTOR MESONS. Talman, R. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Nuclear Studies). pp 145-174 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 42 refs.

This report covers exclusive production of pseudoscalar and vector mesons, with emphasis on electroproduction. After some general comments, remarks are made on total virtual cross sections. For reference the connection is made with single-arm inelastic electron scattering. The formalism used is set out with emphasis placed on the longitudinal-transverse separation. Low t production of pseudoscalar mesons includes discussion of $\pi^\pm$ photoproduction, $\pi^\pm$ electroproduction, π^0 photoproduction and K^+ photoproduction and electroproduction. Data on the production of pseudoscalar mesons at high t is also presented. Total cross sections and shrinkage are discussed for rho electroproduction. The sparse data on electroproduction of other vector mesons is mentioned. The measurement of the η^0 lifetime by the Primakoff effect is discussed. (BRH)

30921 PHOTOPRODUCTION EXPERIMENTS. Fischer, H. M. (Bonn Univ. (F.R. Germany). Physikalisches Inst.). pp 77-116 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27 –31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 59 refs.

Before discussing the new experimental achievements of photoproduction in the resonance region the author summarizes a few facts about the resonance behavior of the pion-nucleon system and also about the formalism which is commonly used for description of the phenomena in the resonance region. A comparison of four photoproduction experiments with their inverse reactions showed agreement within the experimental errors. A "dip test" using π^-/π^+ ratio measurements and the recent ABHHM results show qualitatively that a possible isotensor contribution to the excitation of the $\Delta(1236)$ is small. Two measurements of the ratio $d\sigma(\gamma n \to \pi^0 n)/d\sigma(\gamma p \to \pi^0 p)$ found an upper limit for such a contribution of 3%. There is, therefore, good reason to believe that the $\Delta I \leqq 1$ rule holds. The author concludes that for interpretation of the phenomena above 1 GeV more theoretical analysis in addition to more experimental data is needed. (BRH)

30922 A MEASUREMENT OF COLLINEAR AND NEARLY COLLINEAR PHOTON PAIRS PRODUCED BY e^+e^- ANNIHILATION AT THE 3100 MeV RESONANCE. Braunschweig, W.; Jordan, C. L.; Martyn, U.; Sander, H. G.; Schmitz, D.; Sturm, W.; Wallraff, W. (Technische Hochschule Aachen (F.R. Germany). 1. Physikalisches Inst.); Berkelman, K.; Cords, D.; Felst, R. Phys. Lett., B; 53: No. 5, 491-494(6 Jan 1975).

Collinear and nearly collinear photon pairs from e^+e^- annihilation have been measured at total energies covering the resonance at 3100 MeV. The observed cross section is in good agreement with the $e^+e^- \to \gamma\gamma$ cross section expected from quantum electrodynamics. Upper limits for the decay modes $(3100) \to \gamma\gamma$, $\pi^0\gamma$ and other modes are derived. (auth)

30923 CONFIRMATION OF THE NEW 3700 MEV NARROW RESONANCE IN e^+e^--COLLISIONS. Criegee, L.; Dehne, H. C.; Franke, G.; Horlitz, G.; Krechlock, W.; Knies, G.; Lohrmann, E.; Mehrgardt, H.; Schmitz, R.; Ranga Swamy, T. N. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Phys. Lett., B; 53: No. 5, 489-490(6 Jan 1975).

The two new, very narrow resonant states discovered at Brookhaven and SLAC were confirmed at the storage ring DORIS of DESY in e^+e^--colliding beam experiments. The widths of the resonances are consistent with the expected energy width of the beams. A fit with a constant background and a gaussian distribution to the experimental points yields the following widths (r.m.s.) and resonant masses: $\sigma(3100) = 0.96 \pm 0.15$ MeV $m(3100) = 3089.5$ MeV, $\sigma(3700) = 1.04 \pm 0.15$ MeV, $m(3700) = 3680.3$ MeV. (auth)

30924 THEORETICAL MECHANISM FOR GENERATING VERY MASSIVE NARROW RESONANCES IN e^+–e^- ANNIHILATION CROSS-SECTIONS. Leiter, D. (Michigan Univ., Mt. Pleasant). Lett. Nuovo Cim.; 12: No. 11, 385-390(15 Mar 1975).

The resonant heavy photon mechanism is studied and the possible role it may play in present and future electron-positron colliding-beam experiments. (JFP)

30925 RATIO OF PHOTOPRODUCTION CROSS SECTIONS OF POSITIVE PIONS ON DEUTERIUM AND HYDROGEN NEAR THE FIRST RESONANCE. Aleksandrov, Yu. M.; Ganenko, V. B.; Grushin, V. F.; Miroshnichenko, I. I.; Sanin, V. M.; Sorokin, P. V. (Physical-Technical Inst., Tashkent). Yadern. Fiz.; 20: No. 5, 915-920(Nov 1974). (In Russian).

The measured values of the ratio of the $\gamma d \to nn\pi^+$ and $\gamma p \to n\pi^+$ differential cross sections are presented in the photon energy region 200 to 400 MeV and for 25 to 140° pion angles. The mean statistical accuracy of the results is ±2.5%, the systematical error is ~±3%. The results are inconsistent with the theoretical calculation in the framework of Chew and Lewis model. (auth)

Weak

Refer also to abstract 29721 and 29722.

30926 MEASUREMENTS OF $e^+e^- \to e^+e^-$, $e^+e^- \to \mu^+\mu^-$, AND $e^+e^- \to \gamma\gamma$ AT CENTER-OF-MASS ENERGIES CLOSE TO 3105 MeV. Ford, R.L.; Beron, B.L.; Hilger, E.; Hofstadter, R.; Howell, R.L.; Hughes, E.B.; Liberman, A.D.; Martin, T.W.; O'Neill, L.H.; Simpson, J.W. (High Energy Physics Laboratory and Department of Physics, Stanford University, Stanford, California 94305); Resvanis, L.K. Phys. Rev. Lett. 34: No. 10, 604-606 (10 Mar 1975).

Independent evidence is presented for the decay of the recently discovered particle ψ (3105) into electron-positron pairs, and new evidence is presented for the decay of this particle into muon pairs. Measurements of the rate of the reaction $e^+e^- \to \gamma\gamma$ at center-of-mass energies in the vicinity of 3105 MeV are also reported. (auth)

30927 INVARIANT-MASS DISTRIBUTIONS FROM INELASTIC ν AND $\bar{\nu}$ INTERACTIONS. Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Messing, F.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 10, 597-600 (10 Mar 1975).

The measured distributions in invariant mass W of the recoiling hadron systems in neutrino- and antineutrino-nucleon inelastic collisions are observed to be significantly different after taking into account the opposite helicities of neutrinos and antineutrinos. These distributions indicate the onset of a new phenomenon in the antineutrino data beginning at an incident energy of about 30 GeV, which appears as an excess of events with $W > 4$ GeV/c^2. (auth)

30928 STUDY OF THREE-BODY CHARGED DECAYS OF K_L^0. Buchanan, C.D.; Drickey, D.J.; Pepper, D.M.; Rudnick, F.D.; Shepard, P.F. (University of California at Los Angeles, Los Angeles, California 90024); Dally, E.; Innocenti, P.; Seppi, E.; Chien, C.; Cox, B.; Ettlinger, L.; Resvanis, L.; Zdanis, R. Phys. Rev. D 11: No. 3, 457-472 (1 Feb 1975).

An experiment using a wire-chamber magnetic spectrometer was performed at SLAC to obtain the form factors for K_L^0 decays. This experiment was designed to measure efficiently all three major decay modes $K_{3\pi}$, K_{e3}, and $K_{\mu 3}$ simultaneously. For the $K_{3\pi}$ decay, we measured the slope parameter $a = -4.69 \pm 0.17$. We find for the semileptonic modes K_{e3} and $K_{\mu 3}$ that $\lambda_+ = +0.044 \pm 0.006$, $\lambda_0 = 0.024 \pm 0.013$, and $\xi(t) = -0.20 \pm 0.15$. All the uncertainties quoted above include systematic effects. (auth)

30929 ELECTRON-NEUTRINO ANGULAR CORRELATION COEFFICIENT a MEASURED FROM FREE-NEUTRON DECAY. Dobrozemsky, R.; Kerschbaum, E.; Moraw, G.; Paul, H.; Stratowa, C.; Weinzierl, P. (Physics Institute, Research Center Seibersdorf, Oesterreichische Studiengesellschaft für Atomenergie GmbH, Lenaugasse 10, A-1082 Vienna, Austria). Phys. Rev. D 11: No. 3, 510-512 (1 Feb 1975).

Measurements of the electron-neutrino angular correlation coefficient a in the free-neutron decay are reported. The method is based on the measurement of the energy spectrum of recoil protons obtained from neutrons inside a highly evacuated tangential reactor beam tube. Spectroscopy was done outside the reactor shielding by means of an electrostatic condenser and an ion-electron converter detector of the coincidence type. The result, based on 30 measured proton-energy spectra, is $a = -0.099 \pm 0.011$, giving $|G_A/G_V| = 1.250 \pm 0.036$. Thus a considerable improvement in accuracy concerning the measurement of a of the free unpolarized neutron has been achieved. The result is in good agreement (auth)

30930 NEUTRAL CURRENTS. Myatt, G. (Oxford Univ. (UK). Dept. of Nuclear Physics). pp 389-406 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 20 refs.

The author discusses briefly the new experimental results concerning neutral currents which have become available since the review of Perkins at the Batavia-Chicago Conference 1972. The outstanding development is that several experiments now show positive evidence for the existence of neutral currents in neutrino interactions. The latter part of the review is devoted to a general review of all data on leptonic and semileptonic neutral currents in neutrino interactions in the context of the Weinberg-Salam unified gauge theory of weak and electromagnetic interactions. (auth)

30931 EXPERIMENTAL STUDY OF THE $K^0 \to \pi^+\pi^-\pi^0$ DECAY. Baldo-Ceolin, M. (Univ., Padua); Bobisut, F.; Calimani, E.; Huzita, H.; Mattioli, F.; Puglierin, G.; Camerini, U.; Fry, W. F.; Haggerty, H. F. Nuovo Cim.; 25A: No. 4, 688-708(21 Feb 1975).

The time distribution of a sample of 192 $\pi^+\pi^-\pi^0$ decays of the K^0-mesons produced by K^+ charge exchange was analyzed and the ratio of the K_S^0 CP-violating amplitude to the K_L^0 CP-conserving was measured: $\eta_{+0} = x + iy = -(0.04 \pm 0.18) + i(0.75^{+0.34}_{-0.30})$. Assuming $x = 0$ it is found that $y = 0.75^{+0.34}_{-0.30}$. Under the hypothesis $x = y = 0$ $\Gamma_{K_L^0 \to \pi^+\pi^-\pi^0} = 2.32^{+1.0}_{-0.8} \cdot 10^6\ s^{-1}$ is obtained. The energy dependence of the decay matrix element is found to be $\alpha = -0.32 \pm 0.03$. (auth)

Strong (Baryon-induced)

30932 (CEA-CONF-2858) NEUTRON-PROTON COINCIDENCE MEASUREMENTS IN THE p + D → p + p + n REACTIONS AT LOW ENERGY AND ITS RELATION TO THE QUASI-FREE SCATTERING. Cocu, F.; Ambrosino, G.; Guerreau, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). [nd]. 3p. (In French). (CONF-740822-13). Dep. NTIS (US Sales Only) $4.00.

From conference on few-body problems in nuclear and particle physics; Quebec, Canada (27 Aug 1974).

A measurement of the cross section for the p(D,p n)p reaction at angles $\Theta_p = 19°5$ and $\Theta_n = -30°$ was carried out with incident proton energies comprised between 6.8 to 11.8 MeV. These results are analyzed in terms of the plane wave Born approximation using asymmetrical wave functions, nucleon-nucleon triplet and singlet potentials and isospin conservation. With a normalization factor of about unity, theoretical and experimental results are in good agreement near the maximum of the peak. It was concluded that the mass of the process can be explained by the quasi-free scattering of two nucleons. Comparison of measurements p,n and p,p coincidence gives the ratio of the triplet singlet potentials. (auth)

30933 (CEA-CONF-2859) BREAK-UP OF DEUTERON IN THE REACTION n + D → n + p + n. Cocu, F.; Ambrosino, G.; Guerreau, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). [nd]. 2p. (In French). (CONF-740822-14). Dep. NTIS (US Sales Only) $4.00.

From conference on few-body problems in nuclear and particle physics; Quebec, Canada (27 Aug 1974).

A study of the protons spectrum produced by the n + D → n + p + n reaction was done with 14.10-MeV energy incident neutrons and a mean detection angle of $\langle\Theta\rangle = 3°$. (auth)

30934 (LBL-3613) PARTICLE PRODUCTION BY RELATIVISTIC HEAVY IONS. Steiner, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-eng-48. 30p. (CONF-740984-1). Dep. NTIS $4.50.

From international conference on high energy collisions involving nuclei; Trieste, Italy (9 Sep 1974).

Some recent experiments are reviewed which involve energetic heavy ions, particles with baryon number $B \geq 1$. The emphasis is primarily on projectile and target fragmentation studies at energies of 1 and 2 GeV per nucleon. (JFP)

30935 (LNF-74/51(R)) ITALIAN COLLABORATION AT SPS: FURTHER REMARKS TO THE EXPERIMENTAL PROGRAMME IN HADRON FRAGMENTATION. Amendolia, S. R.; Baroncelli, A.; Bellini, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 21 Aug 1974. 40p. Dep. NTIS (US Sales Only) $5.00.

The description of the experimental program in hadron fragmentation includes how well and to what extent the pattern recognition for many-body events is possible, the triggering of the spectrometer, and the solution of the problem of identification. (JFP)

30936 (LUIP-CR-74-12) MULTIPLICITY, MULTIPLICITY MOMENTS, AND ANGULAR DISTRIBUTIONS IN PROTON-NUCLEUS INTERACTIONS AT VERY HIGH ENERGY. Otterlund, I. (Lund Univ. (Sweden). Fysiska Institutionen). Sep 1974. 19p. (CONF-740984-3). Dep. NTIS (US Sales Only) $4.00.

From international conference on high energy collisions involving nuclei; Trieste, Italy (9 Sep 1974).

A summary of results from 200-GeV proton-nucleus interactions is given. Data recently obtained at 300 GeV by the Barcelona-Batavia-Belgrade-Lund-Montreal-Nancy-Ottawa-Paris-Rome-Strasbourg-Valencia collaboration are presented. A model for short-time behavior of hadronic interactions is presented and used for studying the correlations between shower particles and heavy prongs. (auth)

30937 (RL-75-005) GENERAL TECHNIQUE FOR THE ANALYSIS OF TWO-AMPLITUDE PROCESSES. Carter, A. A. (Science Research Council, Chilton (UK). Rutherford Lab.). Jan 1975. 20p. (RPP/H-137). Dep. NTIS (US Sales Only) $4.00.

The method of zeros given originally by Barrelet for spin $0 + \frac{1}{2} \to 0 + \frac{1}{2}$ reactions is extended to other processes described by two amplitudes, in particular $\bar{p}p \to \pi^-\pi^+$ and $\bar{p}p \to K^-K^+$. The generalization to two-body processes with more complicated spin dependence, e.g., $\frac{1}{2} + \frac{1}{2} \to \frac{1}{2} + \frac{1}{2}$ is straightforward. (auth)

30938 SCALING OF MULTIPLICITY AND ANGULAR DISTRIBUTIONS IN p-EMULSION INTERACTIONS AT 30, 67 AND 200 GeV. Martin, J. W. (Univ. of Washington, Seattle); Florian,

J. R.; Kirkpatrick, L. D.; Lord, J. J.; Gibbs, R. E. Nuovo Cim.; 25A: No. 3, 447-452(1 Feb 1975).

Data on charged multiplicity and angular distributions from interactions of (30 to 200) GeV protons in emulsion are presented. These distributions were found to satisfy KNO-like scaling relations in the variable $z = n/\langle n \rangle$, where n is the charged multiplicity. (auth)

30939 INCLUSIVE PION PRODUCTION IN COLLISIONS OF RELATIVISTIC PROTONS, DEUTERONS, ALPHAS, AND CARBON IONS WITH NUCLEI. Papp, J.; Jaros, J.; Schroeder, L.; Staples, J.; Steiner, H.; Wagner, A.; Wiss, J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 34: No. 10, 601-604 (10 Mar 1975).

We have measured single-particle inclusive spectra of π^+ and π^- mesons produced at 2.5° (lab) in the collision of 1.05-4.2-GeV protons, 1.05- and 2.10-GeV/nucleon deuterons and α particles, and 2.10-GeV/nucleon ^{12}C nuclei with various targets at an angle of 2.5° (lab). The negative-pion spectra show scaling behavior. The results are compared to a simple model in which individual nucleons in the projectile interact with the target to produce pions. (auth)

30940 A-PROTON ELASTIC SCATTERING FROM 1 TO 17 GeV/c. Anderson, K.J. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637); Gelfand, N.M.; Keren, J.; Tan, T.H. Phys. Rev. D 11: No. 3, 473-477 (1 Feb 1975).

The A-proton elastic scattering cross section has been measured between 1 and 17 GeV/c in a bubble chamber experiment. These are the first measurements of the elastic cross section for $p_\Lambda > 5$ GeV/c. The Λ's were produced by 25-GeV/c proton interactions in a platinum target. The cross section falls from 22 to 4 mb over the region. No significant polarization is observed. (auth)

30941 MULTI-BODY PRODUCTION OF MESONS. Meyer, H. (California Univ., Santa Cruz (USA)). pp 175-199 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 49 refs.

The way in which individual final states build up the total cross sections is discussed. Photoproduction data on neutron and proton targets with particular emphasis on possible differences between them is dealt with. The few results on electroproduction which are available are examined as a function of Q^2 and W. Again for electroproduction, particle production is looked at in terms of t and M_X, the t-channel variables, and finally, on possible contributions from individual final states to the π^+/π^- ratio. (BRH)

30942 COSMIC RAY RESULTS ON THE A DEPENDENCE OF MULTIPLICITY AND ANGULAR DISTRIBUTIONS IN PROTON NUCLEAR INTERACTIONS ABOVE 100 GeV. Vishwanath, P. R.; Bussian, A. E.; Jones, L. W.; Lyon, D. E. Jr. (Michigan Univ., Ann Arbor (USA)); Learned, J. G.; Reeder, D. D.; Wilkes, R. J. (Wisconsin Univ., Madison (USA)). Phys. Lett., B; 53: No. 5, 479-483(6 Jan 1975).

A calorimeter-spark chamber system was used to collect data on several hundred proton-nucleus interactions above 100 GeV using targets of C, Al, Fe, Sn, and Pb. The average charged prong multiplicity is found to depend on atomic mass number as $\langle n_c \rangle = \langle n_c \rangle_{(p-p)} A^\chi$ where $\chi = 0.129 \pm 0.004$, with the dominant increase in multiplicity occurring in the backward (p-p c.m.) hemisphere. The value of χ shows no significant energy dependence. (auth)

30943 ANGULAR CORRELATIONS BETWEEN THE CHARGED PARTICLES PRODUCED IN pp COLLISIONS AT ISR ENERGIES. Eggert, K.; Frenzel, H.; Thome, W. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.); Betev, B.; Darriulat, P.; Dittmann, P.; Holder, M.; McDonald, K. T.; Modis, T.; Pugh, H. G. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 86: No. 2, 201-215(10 Feb 1975).

An analysis of rapidity and azimuthal correlations between the charged products of pp collisions at ISR energies is presented. The use of streamer chambers as detectors permits a study of the correlation mechanism at fixed multiplicities. The analysis is restricted to the central rapidity region to suppress diffractive production. A strong short-range correlation is observed, which can be described by independent emission of low-multiplicity clusters, suggestive of abundant resonance production. (auth)

30944 OBSERVATION OF DIFFRACTION EXCITATION IN $pp \rightarrow (p\pi^+\pi^-) + X$ AT THE CERN-ISR AND TESTS OF LIMITING FRAGMENTATION. Baksay, L.; Boehm, A.; Foeth, H.; Staude, A. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.); Lockman, W.; Medinnis, M.; Meyer, T.; Rander, J.; Schlein, P.; Trippe, T. Phys. Lett., B; 53: No. 5, 484-488(6 Jan 1975).

In a single-arm magnetic spectrometer experiment at the CERN Intersecting Storage Rings (ISR), a prominent diffractive enhancement is observed for inclusive production of $(p\pi^+\pi^-)$ systems near $\chi \sim 1$ at $\sqrt{s} = 53$ and 35 GeV. In testing limiting fragmentation and scaling for this system, inclusive $p\pi^+\pi^-$ diffractive excitation into a fixed invariant mass range is found to possess a cross section independent of s to within (3 ± 5)%. The main component in the $(p\pi^+\pi^-)$ system is $\Delta(1236)\pi$, with a charge structure compatible with the break-up of an isotopic spin ½ system. (auth)

30945 GROWTH OF PROTON-PROTON TOTAL CROSS-SECTION IN THE ISR REGION. Ganguli, S. N. (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 12: No. 5, 155-160(1 Feb 1975).

The energy dependence of the proton-proton total cross sections in the range 290 to 2000 GeV is examined using the ISR. Also the growth of the charged multiplicity is discussed. (JFP)

30946 MISSING MASS SPECTRA IN p-p INELASTIC SCATTERING AT TOTAL ENERGIES OF 23 GeV AND 31 GeV. Albrow, M. G.; Bagchus, A.; Barber, D. P.; Bogaerts, A.; Bosnjakovic, B.; Brooks, J. R.; Clegg, A. B.; Erne, F. C.; Gee, C. N. P.; Locke, D. H. pp 65-93 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21-23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

Results are reported of measurements of the momentum spectra of protons emitted at small angles in inelastic reactions at the CERN ISR. The data are for total energies of 23 GeV and 31 GeV. The structure of the peak at low values of the missing mass M (of the system recoiling against the observed proton) is studied. The missing mass distributions have the form $(M^2)^{-B(t)}$ where t is the four-momentum transfer squared. B(t) drops from 0.98 ± 0.06 at $t = -0.15$ GeV^2 to 0.20 ± 0.15 at $t = -1.65$ GeV^2. The results are compared with a simple triple-Regge formula. (FR)

30947 THE LEADING PARTICLE EFFECT AND RISE TO THE PLATEAU FOR INCLUSIVE DISTRIBUTIONS. Meunier, J. L. (Nice Univ., 06 (France). Lab. de Physique Theorique). pp 131-146 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21-23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]). (In French).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

The one-pion inclusive spectra $pp \rightarrow \pi + X$ at NAL and ISR energies are studied. At y = 0 (y being the rapidity) $d\sigma/dy$ increases with energy and seems, moreover, to behave as $S^{-\frac{1}{2}}$ rather than $S^{-\frac{1}{4}}$. It is shown that the energy momentum conservation and leading particle effect lead, within the scope of simple hypotheses, to a secondary term, which can be interpreted as a Q type singularity of intercept $\alpha(Q) = 0$ and negative residue in the spectrum of the particles produced. This means that the rise of the plateau of inclusive spectra is interpreted as a reflection in the sense given by Berger and Krzywicki with the following three effects: scale invariance reached in $S^{-\frac{1}{2}}$ at fixed y(cm), scale invariance reached in S^{-1} at fixed y-y(proj) and downward concavity of the spectrum. (FR)

30948 SPIN EFFECTS IN PROTON-PROTON ELASTIC SCATTERING NEAR THE FORWARD DIRECTION. Bourrely, C.; Soffer, J. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique); Wray, D. (University Coll., London (UK). Dept. of Physics). pp 147-164 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21-23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

Several sets of experimental data on p-p elastic scattering in the Coulomb interference region in the range p(lab) comprised between 9 and 500 GeV/c are analyzed in order to estimate the size of the spin dependent part of the strong amplitude. The ratio β of this spin-dependent part of the spin independent amplitude in the forward direction is introduced. All the data strongly suggest but do not conclusively prove a non-negligible β whose value is around 10% and approximately constant with energy. This result cannot be explained theoretically in terms of exchange of any simple factorizing Regge pole. Important pomeron cut contributions are suggested. Implication of the analysis for some experiments at ISR energies which appears to give rising total cross sections are discussed. (FR)

30949 EXPERIMENTAL RESULTS ON CORRELATIONS BETWEEN PHOTONS AND CHARGED PARTICLES. Schubert, K. R.

(Hamburg Univ. (F. R. Germany). 2. Inst. fuer Experimentalphysik). pp 111-122 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21-23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

Measurements of inclusive two-particle production in the reaction $p + p \rightarrow \gamma +$ anything were performed for four centre-of-mass energies s at two production angles of charged particles (ch) and at eight production angles of the γ-rays. Charged particles are predominantly pions and the single γ-rays are predominantly from π^0 decay. The correlation function $R(\gamma\ ch)$ is positive over the rapidity range $y = y(\gamma) - y(ch) = 3,5$; at $s = 30$ GeV $R(\gamma\ ch)\ (0,0) = 0.62 \pm 0.08$; it is a decreasing function of γ. When $\gamma^*(ch)$ is displaced towards the fragmentation region a plateau is observed. The correlation length and the peak correlation strength are independent of s within the errors in the s range from 530 to 2800 GeV^2. Results evidence a short-range correlation and the character of the peak correlation strength stands against the dominance of a single heavy cluster process. (FR)

30950 CHARGED PARTICLE RATIOS IN PROTON-PROTON COLLISIONS AT VERY HIGH ENERGY. Capiluppi, P.; Giacomelli, G.; Rossi, A. M.; Vannini, G. (Bologna Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Bologna (Italy)); Bussiere, A. (European Organization for Nuclear Research, Geneva (Switzerland); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). pp 95-110 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21-23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]). (In French).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

New results are presented on the inclusive production of charged particles ($\pi^+\pi^-$, K^+K^-, $p\bar{p}$) in mean-angle proton-proton collisions. The experiment corresponded to an intermediate region covering part of the fragmentation zone and part of the central zone. The particles detected have a transverse impulsion $0.15 < = p(T) < = 1.5$ GeV/c and a rapidity $0.5 < = y(lab) < = 2.5$. The results are given in the form of the invariant cross section. For $p(T) = 0.4$ GeV/c the particle/antiparticle ratios tend towards 1 at very high energy but this ratio is still about 2 at ISR energies. The particle/pion ratios increase, except for p/π^+ which drops to about 0.1 in the central region. For $y(lab) = 1.5$ and $x = 0.16$ (x = Feynman's variable) the particle/pion ratios increase strongly with p(T), saturation being reached at $p(T) = 1.2$ GeV/c and $y(lab) = 1.5$; the particle/antiparticle ratios increase slightly with p(T) for $y(lab) = 1.5$ and decrease slightly for $x = 0.16$. (FR)

30951 NEW RESULTS ON CHARGED PARTICLE PRODUCTION IN THE CENTRAL REGION OF PROTON PROTON COLLISIONS AT THE CERN ISR. Alper, B.; Boeggild, H.; Booth, P.; Carroll, L. J.; von Dardel, G.; Damgaard, G.; Duff, B.; Hansen, K.; Jackson, N.; Jarlskog, G. pp 39-50 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21-23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

Inclusive charged particle production at 90° was studied. Results show that at low momentum ($p(T) < 1$ GeV) pion production dominates over kaon and nucleon production by an order of magnitude. The pion invariant cross sections fall rapidly with an average exponential slope in p(T) of -6 (GeV/c)$^{-1}$ and with an overall charge ratio close to 1. It was however observed that at higher transverse momenta the fall-off of the invariant cross section is less rapid and that the data is better described by a power dependence of the transverse momentum in $p(T)^{-8}$. The charge ratios in this region show a surplus of positive particles over negative and the heavier particles are more abundantly produced. While the invariant production spectra in the low p(T) region show only an insignificant dependence on the collision energy, s, a quite spectacular s-dependence develops above p(T) 3 GeV/c for neutral pion production. An increasing s-dependence with p(T) is also observed for charged pion production. (FR)

30952 RISING CROSS SECTIONS AND DIFFRACTION. Capella, A. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique Theorique et Particules Elementaires). pp 1-11 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21-23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]). (In French).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

It is shown that the following two results obtained on I. S. R.'s can be related: a) the proton-proton total cross section, sigma (tot) and inelastic cross section sigma (inel), increase by about 10% in the I. S. R energy range. Whereas sigma (tot) is constant at the energies of conventional accelerators and increases only at those of the I.S.R.'s, the growth of sigma (inel) is continuous; b) the proton spectrum in the inclusive reaction $p + pp + X$ shows two very pronounced peaks near the edges of the kinetic region ($x = \pm 1$). It is shown that if scaling is assumed for inclusive spectra the proton-proton cross section should increase with energy, to about the extent observed experimentally. The result obtained is interpreted on the basis of two perturbation models of strong interactions, the fire-ball expansion model (FEM) proposed by G. Chew and Gribov's reggeon calculation. (FR)

30953 CHADWICK'S NEUTRON. Feather, N. (Univ. of Edinburgh). Contemp. Phys.; 15: No. 6, 565-572(Nov 1974).

The article is a personal account of events surrounding the discovery of the neutron from 1920, when Rutherford speculated, in a lecture, on the possibility of the existence "of an atom of mass 1 which has zero nucleus charge", and 1932, when Chadwick wrote to Nature under the title "Possible existence of a neutron." Much material is quoted from so far unpublished sources, especially from correspondence between Sir James and the author. (UK)

30954 STRANGE-PARTICLE PRODUCTION IN $\bar{p}p$ COLLISIONS AT 5.7 GeV/c. Atherton, H.; Bar-Nir, I.; French, B. R. (CERN, Geneva). Nuovo Cim.; 25A: No. 1, 1-15(1 Jan 1975).

The $\bar{p}\Lambda^0K^+$, $\bar{p}\Lambda^0K^0\pi^+$, and $\bar{p}\Lambda^0K^+\pi^0$ strange-particle final states, produced in $\bar{p}p$ collisions at 5.7 GeV/c, were studied in the CERN 2 meter HBC. Cross sections for the various channels are presented. It was found that about half of the channel cross sections are accounted for by resonance production. Several features of the resonance production are discussed. The results are compared with those obtained in pp interactions at a similar energy. (auth)

30955 EXPERIMENTAL STUDY OF $\bar{p}n$ ANNIHILATIONS BETWEEN 1.0 and 1.6 GeV/c. Huesman, R. H. (Univ. of California, Berkeley); Alston-Garnjost, M.; Ross, R. R.; Solmitz, F. T. Nuovo Cim.; 25A: No. 1, 91-109(1 Jan 1975).

The $\bar{p}n$ annihilations into three and five charged mesons with or without neutrals were studied in order to measure the contributions of the various final states to the 5.5 mb enhancement discovered in the total $I = 1$ $\bar{N}N$ cross section at 2190 MeV total c.m. energy. Fits were performed to the cross sections as functions of the incident-$\bar{p}$ momentum with background plus a resonant term. The fits show enhancements in several final states, the statistically most significant one being in the reaction $\bar{p}n \rightarrow \pi^+2\pi^-$ ((0.51 ± 0.13) mb over a background of 1.4 mb). Less significant effects are also found in all other pionic annihilation final states regardless of their G-parity. (auth)

30956 INVESTIGATION OF RESONANCE PRODUCTION IN INELASTIC PROTON INTERACTION AT THE MOMENTUM OF 19.1 GeV/c. Takibaev, Zh. S.; Boos, E. G.; San'ko, L. A.; Zaitsev, K. G. (Inst. of High Energy Physics, Alma-Ata, USSR). Yadern. Fiz.; 20: No. 5, 964-971(Nov 1974). (In Russian).

Hadronic resonances are investigated in the reactions $pp \rightarrow pp\pi^+\pi^-$, $pp \rightarrow pp\pi^+\pi^-\pi^0$, $pp \rightarrow pn\pi^+\pi^+\pi^-$. It is shown that at the given energy nucleon resonances are mainly produced. The Δ_{1236} isobar production cross section as function of the incident momentum is studied. The experimental ratios for production of the Δ_{1236} isobar in various charge states are compared with the calculated values obtained, assuming that the colliding nucleons exchange by a pion. (auth)

30957 SOME PROPERTIES OF PARTICLES GENERATED AT THE ANGLES $\theta_L > 90°$ IN NUCLEUS-NUCLEUS INTERACTIONS. Avetyan, F. A.; Babayan, Kh. P.; Marutyan, N. A.; Sarkisova, L. G. (Inst. of Physics, Erevan). Yadern. Fiz.; 20: No. 5, 972-975(Nov 1974). (In Russian).

Experimental data on particles, generated in nucleus-nucleus interactions into the backward hemisphere are presented. An average fraction of the energy transferred to these particles, with account of the energy per an incident nucleon, is obtained to be $\langle E^*/\gamma M \rangle = 0.28 \pm 0.05$. The average transversal momentum $\langle p_\perp \rangle = 146 \pm 18$ MeV/c deviates essentially from the conventional value. (auth)

30958 INVESTIGATION OF THE REACTION $np \rightarrow np\pi^+\pi^-$ IN THE 2 TO 10 GeV ENERGY RANGE. Gasparyan, A. P.; Kopylova, D. K.; Nikitin, A. V.; Troyan, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 5, 927-933(Nov 1974). (In Russian).

The reaction $np \rightarrow np\pi^+\pi^-$ is studied in 2 to 10 GeV energy range. The presented data do not contradict the OPE mechanism at ener-

gies up to 5 GeV. At high energies one must take into account the Pomeranchuk pole exchange, as well as the multiperipheral diagrams with possible ρ^0 meson production. The ρ^0 meson production cross section is estimated for 6.6 and 9.1 GeV/c mean momentum of the incident neutron. The corresponding cross sections are 48 ± 16 and 150 ± 30 μb. (auth)

Strong (Meson-induced)

30959 (CEA-N-1732) MEASUREMENT OF THE POLARIZATION PARAMETER IN THE REACTIONS $\pi^-p \to \pi^0n$ AND $\pi^-p \to \eta n$ FOR LARGE MOMENTUM TRANSFERS AT INCIDENT BEAM MOMENTA OF 4.90 AND 7.85 GeV/c. Bonamy, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Jul 1974. 141p. (In French). Dep. NTIS (US Sales Only) $10.25.

A polarized butanol target is used to measure the polarization parameter. The 2 γ's from the π^0 or η decay are observed while the recoiling neutron is not detected. The background resulting from interactions involving bound protons is measured separately with special targets and then subtracted. The polarization for the reaction $\pi^-p \to \pi^0n$ is found to be positive and is consistent with other pion–nucleon scattering data. The results conflict with early Regge predictions using cuts, but they agree with predictions where two poles $\rho + \rho'$ are involved. For the reaction $\pi^-p \to \eta n$, the polarization is not significantly different from zero, but statistical uncertainties do not allow one to draw conclusions. (auth)

30960 (DESY-75/03) LARGE MOMENTUM TRANSFER CORRECTIONS TO THE GLAUBER MODEL IN NONRELATIVISTIC EIKONAL EXPANSION. Rek, Z. J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Jan 1975. 25p. Dep. NTIS (US Sales Only) $4.25.

Corrections to the Glauber model for hadron-deuteron scattering in the realm of nonrelativistic eikonal expansion are expressed through two-body scattering amplitudes. Numerical calculations including offshell effects are carried out and the comparison with experimental data is given for elastic π^-d scattering at 9 GeV/c. Dependence of the relative values of corrections on parameters of input amplitudes is checked. It turns out that this type of corrections does not exceed 22% at the largest momentum transfer measured, $t \approx -2$ (GeV/c)^2. (auth)

30961 PRODUCTION OF ρ^- MESONS ON NUCLEI BY 3.9–GeV/c π^- MESONS AND CROSS SECTION OF ρ^-N INTERACTION. Vasil'kova, A.D.; Gornov, M.G.; Korotkikh, V.L.; Lapushkin, S.V.; Ponosov, A.K.; Protasov, V.P.; Sergeev, F.M. (Moscow Engineering Physics Institute). JETP Lett. 20: No. 10, 311-312 (20 Nov 1974).

We investigated the production of negative ρ mesons on nuclei of the freon mixture (C, F, Cl) by 3.9–GeV/c π^- mesons in the reaction $\pi^- + A \to \rho^- + A^*$. The cross section in the momentum–transfer interval $0.04\ (\text{GeV/c})^2 \leq |t| \leq 0.5\ (\text{GeV/c})^2$ is 3.0 ± 0.3 mb for the average mixture nucleus (A=22.5). Within the framework of the Glauber model, we determined the cross section for the interaction of the ρ^- meson with an intranuclear nucleon, namely $\sigma_{\rho^-N} = 30^{+11}_{-8}$ mb. (auth)

30962 MULTIPLE PION PRODUCTION IN π–Ne COLLISIONS AT 10.5 AND 200 GeV. Elliott, J.R.; Fortney, L.R.; Goshaw, A.T.; Lamsa, J.W.; Loos, J.S.; Robertson, W.J.; Walker, W.D.; Yeager, W.M. (Physics Department, Duke University, Durham, North Carolina 27706); Binkley, M.E. Phys. Rev. Lett. 34: No. 10, 607-610 (10 Mar 1975).

We have measured the multiplicities of pions produced in the collisions of π mesons with neon nuclei at bombarding momenta of 10.5 and 200 GeV/c. The diffractive production of pions is clearly separable. If one excludes the diffractive part, the pion multiplicity obeys the same Koba–Nielsen–Olesen scaling as found previously for $\pi^- - p$ collisions. This fact would seem to indicate the validity of an energy–flux or collective–variable description of the production process. A surprisingly large number of energetic protons (> 1 GeV/c lab momentum) are found to be produced in π–Ne collisions. (auth)

30963 STUDY OF THREE QUASI–TWO–BODY CHANNELS FROM π^+p INTERACTIONS AT 3.9 GeV/c. Haber, B.; Hodous, M.F.; Hulsizer, R.I.; Kistiakowsky, V.; Levy, A.; Pless, I.A.; Singer, R.A.; Wolfson, J.; Yamamoto, R.K. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 11: No. 3, 495-509 (1 Feb 1975).

The $p\pi^+\pi^0$ and $p\pi^+\pi^+\pi^-$ final states from π^+p interactions at 3.9 GeV/c have been analyzed by the prism–plot technique and the following three quasi–two–body channels have been studied in detail: $\pi^+p \to \rho^+p$, $\pi^+p \to \pi^0\Delta^{++}$, and $\pi^+p \to \rho^0\Delta^{++}$. Results are presented on cross sections, differential cross sections, and single and joint spin density matrix elements. These are compared with the Dar–Watts–Weisskopf absorption model and Reggeized pion–exchange model predictions. Relations among joint spin density matrix elements for $\rho^0\Delta^{++}$ are compared with quark–model predictions. (auth)

30964 AZIMUTHAL CORRELATIONS IN 40 GeV/c π^-p COLLISIONS AND THE INDEPENDENT CLUSTER MODEL. Ranft, G.; Ranft, J. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik); Sabau, M.; Fadeev, K. G.; Solomin, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Nucl. Phys., B; 86: No. 1, 63-76 (3 Feb 1975).

Data on azimuthal correlations and their rapidity dependence are presented in inclusive and semi-inclusive reactions $\pi^-p \to \pi^+\pi^+X \to \pi^-\pi^-X$, and $\pi^+\pi^-X$ at 40 GeV/c. They show a long range as well as a short range effect. The short range effect, leading to different behavior of $dN/d\phi$ near $\phi = 0$ of like and unlike pion pairs is explained by identical and unidentical particle statistics. The predictions of the independent cluster model for the azimuthal asymmetry are in qualitative agreement with data of this experiment as well as those at 102 and 205 GeV/c. (auth)

30965 THE REACTION $K^-p \to K^-\pi^+n$ AT 3.6 GeV/c. McCubbin, N. A.; Lyons, L. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Phys., B; 86: No. 1, 13-62 (3 Feb 1975).

By measuring 121 000 2-prong interactions on the Oxford PEPR, 9,543 events of the type $K^-p \to K^-\pi^+n$ were obtained. The cuts to improve the quality of the data and to reduce ambiguities with other final states are described in detail. Strong signals corresponding to the final states $\bar{K}^{*0}$ (890)n and $\bar{K}^{*0}$ (1420)n are observed. The masses and widths of these resonances are determined. The differential cross section for $\bar{K}^{*0}$ (890)n is less steep than that for the reaction $K^+n \to K^{*0}$ (890)p. The decay of the $K^-\pi^+$ system in the 890 MeV region is analyzed as a coherent mixture of spins 0^+ and 1^-, and the density matrix elements extracted. The combination $\rho^H_{00}\, d\sigma/dt'$ has the sharpest t' dependence. A comparison is made with the reaction $K^-p \to K^{*-}$ (890)p to study the t-channel isospin contributions to the various helicity substates. The $K^-\pi^+$ mass spectrum appears distorted on the low side of the $\bar{K}^{*0}$ (1420) at low momentum transfers, thus complicating a study of this region. The $\bar{K}^{*0}$ (1420)n final state has a shallower t' dependence than for $\bar{K}^{*0}$ (890)n; this is in contrast with K^+N data at higher energies. Finally the moments of the $K^-\pi^+$ system's decay distribution were studied as a function both of mass and of momentum transfer. (auth)

30966 PRISM PLOT ANALYSIS OF THE REACTION $\pi^+p \to p\pi^+\pi^0$ AT 16 GeV/c. Deutschmann, M.; Schmitz, P.; Schulte, R. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.); Klein, M.; Nahnhauer, R. (Akademie der Wissenschaften der DDR, Berlin); Boeckmann, K.; Plothow, H.; Zobernig, G. (Bonn Univ. (F.R. Germany). Physikalisches Inst.); Coghen, T.; Counihan, M. J. Nucl. Phys., B; 86: No. 2, 221-242 (10 Feb 1975).

A study of the reaction $\pi^+p \to p\pi^+\pi^0$ at 16 GeV/c incident momentum has been made using the prism plot analysis to reject background events arising from elastic and multineutral contaminations and to separate different reaction channels (ρ^+p, g^+p, $\Delta^+\pi^+$, $\Delta^{++}\pi^0$, $\pi^+(p\pi^0)_{DD}$). Cross sections, invariant mass distributions and production and decay angular distributions are presented. For the channel corresponding to proton diffraction dissociation strong violation of both s- and t-channel helicity conservation is found for low values of the $(p\pi^0)$ mass. It is demonstrated that the prism plot method provides a better separation of background events than conventional methods using kinematic cuts. (auth)

30967 SPIN-PARITY STRUCTURE OF THE (Kπ) SYSTEM PRODUCED IN THE REACTION $K^-p \to (K^-\pi^+)n$. Lauscher, P.; Otter, G.; Wleczorek, H. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.); Matthaeus, E.; Schreiber, H. J. (Akademie der Wissenschaften der DDR, Berlin); Cocconi, V. T.; Counihan, M. J.; Hansen, J. D.; Kellner, G.; Kotanski, A. Nucl. Phys., B; 86: No. 2, 189-200 (10 Feb 1975).

A spin-parity analysis is presented of the $(K^-\pi^+)$ system produced in the reaction $K^-p \to (K^-\pi^+)n$ at 10 and 16 GeV/c for $M(K\pi) < 1.68$ and $|t_{pn}| < 0.2$ GeV^2. The (Kπ) system is dominantly produced by pion exchange with absorption, but the contributions of natural parity exchanges are not negligible. In (46 ± 3)% of the cases the (Kπ) system is in an S-wave state whose mass and phase variation are found to be consistent with a Breit-Wigner resonance with mass value $M_0 = 1245 \pm 30$ MeV and width $\Gamma_0 = 485 \pm 80$ MeV. Cross sections for the individual J^P states are presented for 10 and 16 GeV/c separately. (auth)

30968 POLARIZATION MEASUREMENT IN INCLUSIVE INTERACTIONS. Kuroda, K. pp 123-129 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21–23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]). (In French).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

Polarization was measured in the inclusive reactions π^+ or $\pi^- + p \to \pi^+$ or π^- + anything at 8 GeV/c, using a polarized proton target. The kinetic momentum of the pions in the final state was

determined by a magnetic analyzer and the nature by a Cherenkov counter. The transverse momentum p(T) was fixed around 0.36 GeV/c, $x = p^*/p^*$ (max) varying from 0.3 to 1.0. The asymmetry ϵ (H) due to free protons is given by ϵ (H) = R ϵ (B) where ϵ (B) is the asymmetry obtained with the polarized target; R is about 9.5. The distributions of the events as a function of X for the two target orientations show a spin effect around x = 1 in the case of the interaction $\pi^+ + p$. (FR)

30969 INCLUSIVE SPECTRA OF PARTICLES IN THE REACTION $\pi^-p \to \Lambda + X$ AND $\pi^-p \to K^0_s + X$ AT 4.85 GeV/c. Aleshin, Yu. D.; Arutyunyants, G. A.; Kiselevich, I. L. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 5, 937-941(Nov 1974). (In Russian).

The inclusive distributions of particles from the reactions $\pi^-p \to X + \Lambda$ and $\pi^-p \to K^0_s + X$ are given at 4.85 GeV/c momentum. Similar spectra obtained at 11.2 GeV/c momentum are compared. (auth)

30970 INVESTIGATION OF π^-N COLLISIONS WITH HIGH MULTIPLICITIES ($n_s \geq 5$) AT p = 40 GeV/c. Abdurakhimov, A. U.; Angelov, N.; Grishin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 5, 954-963(Nov 1974). (In Russian).

Momentum and angular distributions for secondary charged π mesons, the inelasticity coefficient, and the distributions in transversal and longitudinal momenta of $\pi^\pm$ mesons produced in reactions $\pi^-N \to N + n\pi^\pm$ ($n_s = 5, 6, \ldots$) at p = 40 GeV/c are presented. The experimental results are compared with predictions of the statistical theory. (auth)

30971 MEASUREMENT OF CROSS SECTION OF THE REACTION $\pi^- + p \to \pi^0 + \pi^0 + n$ AT THE ENERGY OF 276 MeV. Kravtsov, A. V.; Kuptsov, A. V.; Nemenov, L. L.; Starchenko, E. A.; Khazins, D. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 5, 942-948(Nov 1974). (In Russian).

Processes with production of two and more γ quanta in the final state at interaction of negative pions with the energy of 276 MeV with protons were detected by means of a set-up containing Cherenkov total-absorption spectrometers, scintillation and Cherenkov counters. Analyzing the obtained results, the cross section $\sigma(\pi^-p \to \pi^0\pi^0n) = (0.27 \pm 0.07)$ mb was determined. (auth)

30972 π^- CHARGE EXCHANGE REACTIONS ON NUCLEI AT 48 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Kut'in, V. M.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Semenov, V. K. (Inst. of High Energy Physics, Alma-Ata, USSR). Yadern. Fiz.; 20: No. 5, 949-953(Nov 1974). (In Russian).

The cross sections of π^- exchange to π^0 and η^0 mesons are measured at 48 GeV/c on the nuclei Li, C, Al, and Cu. Those cross sections are compared with the cross sections obtained earlier for the hydrogen and the effective numbers of protons are determined. The results show that the absorption of η^0 mesons in nuclear matter is weaker than the absorption of π^0 mesons. The total cross section of η^0 interaction with nucleons is obtained to be $\sigma_{tot}(\eta^0N) = 15 \pm 5$ mb, which value is consistent with the quark model. (auth)

30973 MULTIPLE PARTICLE PRODUCTION IN 25 GEV/c ENERGY REGION. Ushida, N. (Aichi Univ. of Education, Okazaki (Japan)). No. 3, 27-32(Mar 1974).

An attempt is made to point out from available accelerator data that the secondary pion distribution from π^--p collision at 25 GeV/c takes a simple form when suitable Lorentz transformation is applied, and that the pion momentum spectrum in the rest frame is well explained by the momentum spectrum from invariant phase space. It is shown that the distribution of secondary particles from π^--p collision at 25 GeV/c can be well described by the phase volume in the decay of an intermediate body with 2.5 ~ 3.1 GeV rest mass and going forward with velocity $\beta = 0.5$ in the center of mass system. It is considered from the momentum conservation law that some of the particles must go backward with their total energy and total momentum equal to 3.3 ~ 3.8 GeV and 1.4 ~ 1.7 GeV/c, respectively. Experiment does not give any information on backward hemisphere. However, it has been known that the nucleons from high energy π^--p collision tend to collimate in backward direction, so that it is expected that momentum conservation is assumed by nucleons and pions. In the same manner, the distribution of secondary particles from p-p collision at 28.5 GeV/c can be described by the phase volume in the decay of an intermediate body with 2.8 GeV rest mass and going forward with velocity 0.55 in the center of mass system. (JA)

30974 POLARIZATION OF A HYPERON FROM MULTIPARTICLE REACTIONS IN π^-p COLLISIONS AT 4.85 GeV/c. Aleshin, Yu. D.; Arutyunyants, G. A.; Kiselevich, I. L. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 5, 934-936(Nov 1974). (In Russian).

The polarization of Λ hyperon produced at 4.85 GeV/c in π^-p collisions in the reaction $\pi^-p \to \Lambda$ + everything is measured. (auth)

30975 SOME PROPERTIES OF PION-CARBON INTERACTIONS AT 5 GeV/c. Azimova, M.; Azimov, S. A.; Budagov, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 5, 921-926(Nov 1974). (In Russian).

Using the one-meter propane bubble chamber of LNR (JINR) the multiplicity distributions of secondary charged particles and pair correlations of protons in the π^{-12}C-interactions at 5 GeV/c are investigated. The comparison of the data on multiplicity with those obtained at 40 GeV/c indicates a possible existence of the KNO-scaling at $E \gtrsim 5$ GeV. The study of the pair correlations of protons confirms the existence of the correlated emission of protons in π^--C-interactions at 4 and 7.5 GeV/c, observed previously. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 31706.

30976 (NP-20352) ANNUAL REPORT, 1973. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Teoretisk Fysik). 1973. 61p. Dep. NTIS (US Sales Only) $6.25.

The Institute of Theoretical Physics is a joint institute for research and education in theoretical physics serving Chalmers University of Technology and the University of Goteborg. The budget for 1973 is summarized and indication given of the number of persons employed at the institute. Brief details are given of research projects in the fields of elementary particle physics, condensed matter physics and mathematical physics. Graduate and undergraduate teaching and the degrees awarded are discussed. Details of visits to other institutions and conferences are given together with lists of published papers and institute reports. (SW)

General

Refer also to abstracts 31609 and 31682.

30977 (AD/A-000629) INTERACTIONS OF HIGH ENERGY PARTICLES AND ATOMIC NUCLEI WITH NUCLEI. Barashenkov, V. S.; Toneev, V. D. 2 Oct 1974. Translated from pp 1-267 of Vzaimodeistviya Vysokoenergeticheskikh Chastits i Atomnykh Yader S Yadrami, Dubna, 1972. (FRD-HC-23-2670-74). 395p. NTIS $10.25.

The topics discussed are interaction cross sections of fast particles and atomic nuclei; elastic scattering of particles and nuclei by nuclei; inelastic interactions of particles with nuclei (experimental data). (auth)

30978 (COO-2232B-66) TECHNICAL PROGRESS REPORT FOR CURRENT AEC CONTRACT, FEBRUARY 1, 1974-FEBRUARY 1, 1975. Pais, A. (Rockefeller Univ., New York (USA)). 1975. Contract AT(11-1)-2232B. 8p. Dep. NTIS $4.00.

A summary of research in theoretical high energy physics is presented. (JFP)

30979 (RL-75-002) HELICITY STRUCTURE OF THE TRIPLE-REGGE FORMULA. Sakai, N.; Uschersohn J. (Science Research Council, Chilton (UK). Rutherford Lab.). Jan 1975. 29p. (T-102). Dep. NTIS (US Sales Only) $4.50.

The dependence of the triple-Regge vertex on three of its five variables is shown to be equivalent to the spin and helicity structure of the missing mass state X in the reaction $a + b \to c + X$. In particular, if the triple-Regge vertex depends only on the squared momentum transfers t, t_1, and t_2, the t-channel helicity in this reaction is conserved. (auth)

30980 GENERALIZED SEQUENTIAL DECAY APPROACH TO MULTIPLE PRODUCTION. Ballestrero, A.; Page, R.; Predazzi, E. (Univ., Turin). Nuovo Cim.; 25A: No. 3, 419-437(1 Feb 1975).

A set of coupled Volterra-like integral equations is derived for all the quantities of physical interest in the multiparticle decay of a fireball formed in a high energy collision process. The basic assumptions are the fireball decays sequentially either directly into pions or through the formation of mesonic clusters (these, in turn, are forced to decay sequentially into pions); each elementary decay of either type occurs with an independent probability except for energy momentum and charge conservation, which are imposed at every single decay step. A graphical method is developed as a short cut to derive the aforementioned integral equations. (auth)

30981 MULTIPLE PRODUCTION OF PARTICLES AND S-CHANNEL UNITARITY IN THE POMERON STRONG COUPLING REGION. Migdal, A. A.; Polyakov, A.M.; Ter-Martirosian, K. A. Zh. Eksp. Teor. Fiz.; 67: No. 6, 2009-2021(Dec 1974). (In Russian).

A scale-invariant solution of the equations of the interacting pomeron theory which corresponds to strong coupling of pomerons at high energies is employed to analyze multipomeron production of particles and inclusive processes. It is shown that due to a power-law decrease of pomeron vertexes in the solution, all difficulties connected with growth of the particle production cross section for $\xi = \ln(s/\mu^2) \to \infty$ are removed, and the s-channel unitarity conditions is likely to be restored. (auth)

30982 ANTIMATTER AS A SOURCE OF NEGATIVE–TEMPERATURE STATES. Rivlin, L.A. Sov. J. Quantum Electron. 4: No. 9, 1151-1151 (Mar 1975).

It is shown that a negative–temperature state may be established in a system composed of particles and antiparticles when the concentration of the latter reaches a certain value. Estimates indicate the possibility of experimental realization of a negative–temperature state when a positron packet reaches a target. (auth)

30983 POSITIVITY CONDITIONS ON THE SPIN DENSITY MATRIX: A SIMPLE PARAMETRIZATION. Chung, S.U.; Trueman, T.L. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 11: No. 3, 633-646 (1 Feb 1975).

A simple parametrization of the spin density matrix ρ is given which ensures that ρ is a positive, Hermitian matrix which satisfies the parity symmetry conditions. There is a minimal number of parameters and they can vary independently; no complicated constraints on their allowed region of variation are required. A similar parametrization is given for the real part of ρ. Rank conditions, polarized targets, and angular distributions are also discussed. (auth)

30984 PLANARITY OF HIGH-ENERGY COLLISIONS. Kostka, P.; Nowak, H.; Schiller, H. (Akademie der Wissenschaften der DDR, Berlin); Gajewski, J. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). Nucl. Phys., B; 86: No. 1, 1-12(3 Feb 1975).

Using a global variable a special type of correlation of the transverse momenta of secondary particles in interactions at medium energies has been found. This dynamical alignment effect which is called "planarity" decreases with the multiplicity and increases with the incoming energy. It is shown that this effect is neither due to the damping of the transverse momenta nor is it caused by the existence of leading particles, resonances or flattened jets. It is in agreement with the assumption that it is caused by the high angular momentum of the initial state. (auth)

30985 REMARKS ON CAUSALITY, VANISHING LONGITUDINAL CROSS-SECTIONS, AND OPERATOR SCHWINGER TERMS. Abdel-Rahman, A. M. M. (Univ. of Khartoum, Sudan). Lett. Nuovo Cim.; 12: No. 6, 189-192(8 Feb 1975).

It is pointed out that an extension of the causality arguments underlying previous work imply that when $\sigma_1 = 0$ the operator Schwinger-term contribution vanishes irrespective of the scaling behavior of νW_2. As an illustration, a specific example is discussed in which νW_2 does not scale. (JFP)

30986 DERIVATIVE ANALYTICITY RELATIONS. Heidrich, J.; Kazes, E. (Pennsylvania State Univ., University Park). Lett. Nuovo Cim.; 12: No. 10, 365-367(8 Mar 1975).

The scope and limits of a new technique which may greatly extend the utility of fixed-momentum-transfer dispersion relations at high energy are discussed. The method appears to dispense with the need to know the imaginary part of the scattering amplitude up to very high energies in order to calculate its real part. It is shown that the imaginary part of the scattering amplitude and its first derivative are sufficient to reproduce its real part at high energy. For the discussion purposes this method is examined in the context of crossing symmetric dispersion relations. (JFP)

30987 NECESSITY OF ZEROS IN THE NEARLY FORWARD ASYMPTOTIC DOMAIN. Cornille, H. (CEN de Saclay, Gif-sur-Yvette, France). Nuovo Cim.; 25A: No. 4, 629-645(21 Feb 1975).

For the elastic reaction $A + B^{\dagger} \to A + B^{\dagger}$ assuming i) $\sigma^{\dagger}_{tot} >$ const (the constant being arbitrarily small), ii) either $\lim_{s\to\infty} d\sigma^{\dagger}/dt = 0$ for fixed $t < 0$ or $\lim_{s\to\infty} \sigma^{\dagger}_{el} = 0$, it is shown that necessarily there exists at least one zero for the real part of the symmetric amplitude in the physical nearly forward asymptotic domain with energy as large and transfer as small as one wants. (auth)

30988 NEW SUPERSELECTION RULE. Castell, L. (Max-Plank-Institut zur Erforschung der Lebensbedingungen der Wissenschaftlich-Technische Welt, Stranberg, Ger.). Lett. Nuovo Cim.; 12: No. 11, 410-412(15 Mar 1975).

The generator of the Lie algebra of the identity component of the conformal group SO(04,2)/C(2) and its covering groups SO(04,2), SU(02,2), etc. up to the universal covering group SO(02,2) and some global aspects of the group SU(02,2) are considered. Applications of the full conformal symmetry for high energy zero-mass and medium-energy reactions are considered. (JFP)

30989 POSSIBLE CONFLICT BETWEEN RENORMALIZED PERTURBATION THEORY AND AN EXACT SOLUTION OF THE TWO-DIMENSIONAL FEDERBUSH MODEL DESCRIBING THE PSEUDOSCALAR INTERACTION OF TWO MASSIVE FERMIONS. Tapper, M. L. (North Dakota State Univ., Fargo). Nuovo Cim.; 25A: No. 1, 165-172(1 Jan 1975).

The backscattering probability amplitude between two massive fermions whose interactions are described by the two-dimensional Federbush model is calculated to second order in renormalized perturbation theory. The calculation yields a nonvanishing amplitude which is in direct conflict with the prediction of a trivial scattering matrix derived from an exact solution of this model studied by Federbush and Wightman. (auth)

Electromagnetic

Refer also to abstracts 31698 and 31703.

30990 (JINR-P2-8476) RADIATIVE CORRECTIONS FOR THE INVERSE PION ELECTROPRODUCTION PROCESS. Shumeiko, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 10p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The radiative corrections for the process $\pi^- p \to n e^+ e^-$ are calculated in the soft-photon approximation. It is shown that in the experimental conditions, in which the electron and the positron are not distinguished, the contribution of the two-photon diagram is zero. (auth)

30991 (RL-75-003) CONTRIBUTION OF THE Δ TO RADIATIVE MUON CAPTURE. Beder, D. S. (Science Research Council, Chilton (UK). Rutherford Lab.). Jan 1975. 15p. Dep. NTIS (US Sales Only) $4.00.

The contribution of Δ^- intermediate states to the process $\mu^- p \to \nu n \gamma$ is calculated. The appropriate vertex functions and coupling constants are established for a Lagrangian description of this contribution, and the various amplitudes for the maximum-photon-energy configuration are examined (algebraically). The result obtained is that the Δ contributes negligibly to singlet $\mu^- p$ capture, and rather weakly to triplet $\mu^- p$ capture, despite surprisingly large individual Δ matrix elements. Polarizations and $\mu^- \gamma$ correlation are, however, significantly affected by the Δ. (auth)

30992 ELECTROPRODUCTION OF VECTOR MESONS ON NUCLEONS IN THE QUARK MODEL. Rekalo, M. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 11, 1852-1859(Nov 1974). (In Russian).

The quark model of interaction of elementary particles is extended to the processes of electroproduction of neutral vector mesons on nucleons and nuclei as well as to the processes on the Compton scattering of virtual γ-quanta by nucleons. A dependence of differential cross sections of meson production on the mass of the virtual γ-quantum and total energy, a relative role of the contribution of different vector meson electroproduction processes to the total cross section of the interaction of virtual γ-quanta nucleons are predicted. (auth)

30993 T-MATRIX FOR THE HULTHEN AND COULOMB INTERACTIONS. Banerjee, S. N. (Jadavpur Univ., Calcutta). Nuovo Cim.; 25A: No. 2, 199-206(21 Jan 1975).

Each term in the S-wave T-matrix for the Hulthén potential, expressed in separable-series form in momentum variables for negative energies, may be approximated so as to represent the corresponding term in the separable expansion of the T-matrix for the Coulomb interaction. For positive energies the off-shell S-wave T-matrix for the Hulthén interaction in the same approximation reproduces the Coulomb potential with a divergent phase factor in the high energy limit. (auth)

30994 POSSIBLE EXPERIMENTAL VERIFICATION OF MICROCAUSALITY IN ELECTROPRODUCTION. Geshkenbein, B.V. JETP Lett. 20: No. 10, 309-310 (20 Nov 1974).

It is shown on the basis of earlier results that the Mellin transform of the forward scattering amplitude decreases exponentially. This statement admits, in principle, of experimental verification. (auth)

30995 ANALYSIS OF THE NARROW–RESONANCE PRODUCTION IN COLLIDING BEAMS. Mikaelian, K.O. (The Pennsylvania State University, University Park, Pennsylvania 16802). Phys. Rev. Lett. 34: No. 10, 611-613 (10 Mar 1975).

I analyze the experimental data on the recently observed heavy resonance J assuming that it is a spin–one particle. The results of this analysis are used to discuss μ–e universality, parity–nonconserving effects, and production cross sections by high–energy ($\geq$20 GeV) photons and electrons. (auth)

30996 ELECTROMAGNETIC DECAY OF THE NEW HEAVY MESONS AT 3.1 AND 3.7 GeV. Borenstein, J.; Shankar, R. (Lyman

Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 10, 619-621 (10 Mar 1975).

We examine some experimental consequences of the "charmonium" picture, in which the boson resonances at 3.1 and 3.7 GeV are interpreted as bound triplet−s states of a charmed quark−antiquark pair. We investigate the radiative decays of the observed resonances into other charmonium states. (auth)

30997 e^+e^- ANNIHILATION INTO HADRONS AND BRIDGING HIGGS PARTICLES. McKay, D.W.; Munczek, H. (Department of Physics and Astronomy, University of Kansas, Lawrence, Kansas 66045). Phys. Rev. D 11: No. 3, 688-691 (1 Feb 1975).

Some of the Higgs particles in unified gauge models should have rather low masses and point couplings to the photon. We estimate their contribution to e^+e^- into hadrons to be of the right order of magnitude and energy dependence. (auth)

30998 TRIDENT ELECTROPRODUCTION OF MUON PAIRS IN DEEP−INELASTIC INCLUSIVE REACTIONS. II. HELICITY ANALYSIS. Koul, B.L.; Pandita, P.N.; Singh, Y. (Department of Physics, University of Kashmir, Srinagar−190006, India). Phys. Rev. D 11: No. 3, 664-670 (1 Feb 1975).

In this paper we analyse the Compton−type amplitude for the process $e + p \to e + \mu^- + \mu^+ +$ "anything" with both the incident electron and the target proton polarized. For a known outgoing−electron and muon−pair polarization, the kinematics for the process is worked out in a form especially suitable for experimental analysis. The differential cross section is expressed in terms of four off−mass−shell Compton−scattering helicity cross sections. The helicity cross sections are further expressed in terms of the invariant structure functions for the above process. The difference between the cross sections for parallel and antiparallel configurations of the incident virtual photon is shown to be related to the matrix element of the commutator of the commutators of currents between nucleon states. Using light−cone arguments we relate this difference to the structure functions which can be obtained from electroproduction and neutrino−induced production experiments. (auth)

30999 AMPLITUDE STRUCTURE AND GAUGE−INVARIANCE CONSTRAINTS FOR DYNAMICAL MODELS OF $\gamma N \to \pi^* \Delta$. Clark, R.B. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 and Department of Physics, Texas A & M University, College Station, Texas 77843); Ugaz, E. Phys. Rev. D 11: No. 3, 671-676 (1 Feb 1975).

An invariant−amplitude formalism is presented which features manifest gauge invariance and provides a convenient separation of the prominent dynamical components for $\gamma N \to \pi^* \Delta$. Kinematic constraints and low−t theorems are analyzed in terms of s− and t−channel helicity amplitudes. Various dynamical models are discussed in terms of the general formalism and constraints. (auth)

31000 HIGH−ENERGY BEHAVIOR, DUALITY, AND THE $SU(6)_W$ STRUCTURE OF THE ELECTROMAGNETIC AND MESONIC TRANSITION OPERATORS. Avilez, C. (Escuela Superior de Física y Matemáticas, Instituto Politecnico Nacional, México 14, D.F., Mexico); Cocho, G.; Dubovoy, M. Phys. Rev. D 11: No. 3, 555-565 (1 Feb 1975).

Using duality and the high−energy behavior of the pseudoscalar−meson photoproduction helicity amplitudes, we perform an analysis of the $SU(6)_W$ structure of the electromagnetic and mesonic transition operators. It is found that spin−orbit terms might be present if the magnetic term is present. If this is not the case, one finds some strong restrictions on hadron couplings. (auth)

31001 ASYMPTOTIC BEHAVIOR OF THE CROSS SECTION FOR $e^+e^- \to$ HADRONS IN ASYMPTOTITCALLY FREE FIELD THEORIES. Healy, J.B. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 11: No. 3, 580-585 (1 Feb 1975).

Asymptotically free field theories make definite predictions for the behavior of the hadronic vacuum polarization tensor in the spacelike region. A theorem due to Meiman is used to combine these predictions with the analyticity of the vacuum polarization tensor to derive in a rigorous way the asymptotic behavior of the cross section for electron−positron annihilation into hadrons. Our theorems allow this cross section to oscillate indefinitely about a well−defined value. An explicit example is exhibited which demonstrates that such oscillations are not excluded and that the restrictions imposed on the annihilation cross section at finite energies are very weak. Even if oscillations of the leading term in the cross section which do not die out asymptotically are excluded as unphysical, very little can be said about the behavior of the nonleading terms without making very restrictive assumptions. (auth)

31002 SHORT−DISTANCE SINGULARITIES IN INCLUSIVE ELECTROPRODUCTION. Brandt, R.A. (Department of Physics, New York University, New York, New York 10003); Wing−Chiu, N. Phys. Rev. D 11: No. 3, 647-655 (1 Feb 1975).

We examine the one−particle inclusive electroproduction process $\gamma (q) + h (p) \to h (p') +$ anything is the scaling limit $\kappa \equiv q^2$, $\nu \equiv q \cdot p$, $\gamma \equiv q \cdot p' \to \infty$, with $\omega \equiv -\kappa/2\nu$, $\eta \equiv \nu'/\nu$, $u \equiv p \cdot p'$ fixed, using the slant singularity formalism we have recently developed. The exponent of the short−distance singularity on the light cone (which we call slant singularity) is calculated in canonical $\lambda\phi^4$ and quark−gluon theories by combining generalized dimensional analysis and multi−Regge analysis. Experimental consequences are discussed, in particular, multiplicities are evaluated for the various models. A comparison with our predictions in the case of e^+e^- annih ation is made. (auth)

31003 COMPARISON OF EXCHANGE MECHANISMS IN $\pi N \to \rho N$ AND PION PHOTO− AND ELECTROPRODUCTION. Irving, A. C. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 86: No. 1, 125-141(3 Feb 1975).

Rho−, photo− and electroproduction are compared and contrasted from a t-channel exchange point of view. A common exchange mechanism is evident. Systematic differences associated with the variable mass of the vector particle are found−in particular, the mass dependence of the non-pole-like contributions is reminiscent of that seen in higher mass resonance production. Naive vector meson dominance arguments which do not allow for these mass-dependent effects are shown to disagree both qualitatively and quantitatively with the data. The implications of this, and similar studies are emphasized for an understanding of absorption effects in two-body scattering. (auth)

31004 UNIFIED MODELS OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Llewellyn Smith, C. H. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 449-465 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27−31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 59 refs.

Spontaneously broken gauge theories provide a framework for the construction of renormalizable models of weak and electromagnetic interactions. In this paper the status of attempts to construct such models is reviewed. First, the ingredients of the models and the role they play are considered. Then the problems encountered in model building and the hopes which might be entertained for future models are discussed. Finally, some brief remarks are made about the implications of the evidence for neutral currents. (auth)

31005 ELECTROMAGNETIC RADII OF NUCLEON AND PION. Hoehler, G.; Pietarinen, E. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Theoretische Kernphysik). Phys. Lett., B; 53: No. 5, 471-475(6 Jan 1975).

A new determination of the spectral functions of nucleon form factors according to the Frazer−Fulco method (using t-channel dispersion relations) leads to reliable results up to $t \leq 1$ GeV^2 and to improved values for the radii. (auth)

31006 KNOWN AND UNKNOWN REGIONS IN LEPTON PHYSICS. Drell, S. D. (Stanford Linear Accelerator Center, Calif. (USA)). pp 493-511 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27−31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). 35 refs.

A review is given of current theoretical and experimental work of observed scaling in electromagnetic processes. The behavior of the elastic electromagnetic form factor of the proton at high Q^2 is discussed. Neutral currents and PCAC are considered and ideas are given concerning the experimental and theoretical progress expected to be made in the next ten years. (BRH)

31007 LIGHT CONE PHYSICS, WHERE DO WE STAND. Preparata, G. (Rome Univ. (Italy). Istituto di Fisica). pp 467-492 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27−31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 66 refs.

Light cone dominance in the Bjorken limit is considered. A few general remarks about the range of direct applications of the light cone approach are made, and it is seen how the observation of light cone dominance in deep inelastic phenomena can be developed into an effective framework to deal with such processes. How one can accommodate in a conventional field theoretical framework the scaling behavior so strikingly exhibited by SLAC's experiments is considered. The role of the gluon model in abstracting algebraic

information concerning LC operator product expansions is discussed. Deep inelastic electron-nucleon and neutrino-nucleon scattering are considered. The relevance and the limitations of a description of e^+e^- colliding beams physics in terms of LC operator product expansions are considered. A brief discussion is presented of the renormalization procedure in conventional e.m. and weak interaction. A useful direction of investigation within the LC framework is a theory of mass dispersion relations for amplitudes involving currents based on LC dominance in the asymptotic region. This problem is briefly considered. The particular applications of the massive quark model are listed. (BRH)

31008 WEAK AND ELECTROMAGNETIC FORM FACTORS OF HADRONS. Gourdin, M. (Paris-6 Univ., 75 (France). Lab. de Physique Theorique et Hautes Energies). pp 407-427 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 70 refs.

Pseudoscalar meson form factors are discussed. The role of electron-positron annihilation $e^+ + e^- \rightarrow M + \bar{M}$ to measure the electromagnetic form factor of the meson M in the timelike region is discussed. Information on the π and K meson form factors in the spacelike region, the inverse electroproduction reaction $\pi^-p \rightarrow e^+e^-n$, and the so-called modulus representation are considered. The most direct method to measure the nucleon axial vector form factor is the elastic scattering of neutrinos and antineutrinos on nucleons. After giving some theoretical formulae, the experimental situation is reviewed. The same axial vector form factor enters the electroproduction amplitudes at threshold due to the PCAC hypothesis together with the nucleon vector form factor. The results of some recent experiments are discussed and it appears that PCAC is valid in this case up to uncertainties due to the extrapolation. (BRH)

31009 THEORETICAL ASPECTS OF PHOTO- AND ELECTROPRODUCTION IN THE RESONANCE REGION. von Gehlen, G. (Bonn Univ. (F.R. Germany). Physikalisches Inst.). pp 117-143 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 101 refs.

Some kinematical considerations about the interdependence of different measurable quantities are discussed. The more detailed topics discussed are: pion photoproduction analyses of the $\Delta(1232)$-region; multipole analyses of the higher resonance regions; photoproduction and quark models; multiple pion photoproduction; eta and kaon photoproduction; sum rules, zeroes, relation to Compton scattering; threshold photo and electroproduction; and resonance electroproduction. It is seen that recent knowledge of the photoproduction amplitude structure in the higher resonance region has improved substantially. Many more resonance couplings have become known with good accuracy. The Melosh transform approach gives an alternative derivation of the successful quark model prediction for the resonance couplings. Time reversal violation and isotensor currents are not required by the experimental data. Problems between theoretical predictions and experimental data have appeared for Compton scattering and π^+ electroproduction in the first resonance region. (BRH)

31010 RECENT RESULTS CONCERNING THE ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. Bloom, E. D. (California Inst. of Tech., Pasadena (USA). Dept. of Physics). pp 227-250 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 27 refs.

The evidence which exists for and against the parton and the light-cone ideas is discussed. Using the moments $B_n(Q^2)$, the data seem consistent with scaling given the uncertainties associated with being at limited Q^2 and s. However, the apparent Q^2 dependence of $B_n(Q^2)$ for $n \sim 3$ indicates a consistency with the ideas of anomalous dimensions also. The resolution of this important point awaits larger Q^2 and s data. The absolute lower bound for $\nu W_2^n/\nu W_2^p$ of 0.25 is not threatened by the data at this time. The new experiments measuring R are certainly consistent with the requirement that $R = r(\omega)/v$; however, greater accuracy is needed before a constraining test of light cone ideas is to be made. Experiments other than inelastic electron measurements have much to say about substructure. Neutrino experiments, though statistically limited, show surprising consistency with the electron data. Also other large P processes show promise for future tests. (auth)

31011 HIGH-ENERGY TWO-BODY PHOTOPRODUCTION. Salin, P. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 201-226 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 73 refs.

This review is devoted to high-energy two-body photoproduction reactions. First, vector meson production as a tool to investigate properties of diffractive reactions is discussed. Some of the striking similitudes between vector meson photoproduction and elastic πN or KN scattering are pointed out. Secondly, a problem which precisely has no counterpart in hadronic reactions, the occurrence of a possible $J = 0$ fixed pole in the Compton amplitude, is considered. This problem has some interesting connections with the possible composite structure of the hadrons. Finally, the author turns to pseudoscalar meson photoproduction with some comments of new experimental facts and a brief survey of the present theoretical investigations. (auth)

31012 DIFFRACTIVE PROCESSES. Moffeit, K. C. (Stanford Linear Accelerator Center, Calif. (USA)). pp 313-351 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 80 refs.

Present knowledge of the diffractive process is summarized. Before showing any data, the properties and characteristics of diffractive scattering are reviewed. The author concentrates primarily on data of photoproduction and electroproduction of vector mesons. Photoproduction and more recently electroproduction has been an extremely useful tool in the study of diffractive production. The advantages are due to the strong coupling of the vector mesons to the $J^P = 1^-$ photon whose initial spin characteristics can be controlled experimentally. This allows one to study the production characteristics using the decay angular distributions of the vector meson decay as an analyzer. The following topics are covered: (i) higher mass vector mesons; (ii) $\pi^+\pi^-$ line shape in dipion photoproduction on complex nuclei; (iii) energy dependence of the t-distribution for the diffractive photoproduction of vector mesons; and (iv) diffractive vector meson electroproduction. (auth)

31013 ELECTROPRODUCTION IN THE RESONANCE REGION. Clegg, A. B. (Lancaster Univ. (UK)). pp 49-76 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 86 refs.

Attempts to obtain information about individual amplitudes for production of resonance and of non-resonant amplitudes as is typical of traditional resonance region work and attempts to find evidence for similar contributions to electroproduction at higher masses are discussed. As well as the production of resonances the author discusses electroproduction of non-resonant backgrounds in the resonance region. The more detailed topics discussed are: measurement of electroproduction at pion threshold; coincidence electroproduction measurements in the first resonance and second resonance regions; electroproduction from deuterium; quark models of photoproduction and electroproduction; and electroproduction of $\pi\Delta$ systems. (BRH)

31014 A THEORIST'S VIEW OF e^+-e^--ANNIHILATION. Bjorken, J. D. (Stanford Linear Accelerator Center, Calif. (USA)). pp 25-47 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 105 refs.

The author emphasizes topics which are either new, especially relevant, or which are represented by contributions to the conference. The results from the first-generation experiments at high energy are discussed in terms of the behavior of the quantity

$R = \sigma_{tot}(e^+e^- \to \text{hadrons})_{1\gamma}/\sigma_{tot}(e^+e^- \to \mu^+\mu^-)$. The topics discussed are total cross section behavior, weak-interaction effects, exclusive channels, two-photon processes and multihadron final states. (BRH)

31015 OFF-DIAGONAL GENERALIZED VECTOR DOMINANCE AND INELASTIC EP SCATTERING. Fraas, H. (Wuerzburg Univ. (F.R. Germany). Physikalisches Inst.); Read, B. J. (SEE CODE- 5677740 Science Research Council, Daresbury (UK). Daresbury Nuclear Physics Lab.); Schildknecht, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nucl. Phys., B; 86: No. 2, 346-354 (10 Feb 1975).

By also taking into account off-diagonal contributions to the virtual forward Compton amplitude, scaling in ep scattering is obtained from scaling of the total cross section for e^+e^- annihilation into hadrons. The parameter which sets the scale for the q^2 dependence in ep scattering is calculated to be $\overline{m}^2 \simeq 0.61\ m_\rho^2 \simeq 0.36$ GeV.^{2} (auth)

31016 RELATIVISTIC EFFECTS ON THE TENSOR POLARIZATION IN ELECTRON–DEUTERON SCATTERING. Sprung, D. W. L.; Srinivasa Rao, K. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Phys. Lett., B; 53: No. 5, 397-400 (6 Jun 1975).

The tensor analyzing power P_e in electron deuteron scattering is calculated including relativistic corrections to the deuteron form factor as determined by Friar and Gross. These effects are found to be quite comparable to the differences between various potentials, and should therefore not be ignored. (auth)

31017 INTERPOLATION FORMULA FOR THE ENERGY RADIATED BY A POINT CHARGE PASSING THROUGH A HOLE IN A PLANE. Maresca, N. J.; Liboff, R. (Cornell Univ., Ithaca, NY). Can. J. Phys.; 53: No. 1, 62-75(1 Jan 1975).

The radiative energy loss E_R accompanying the transition of a uniformly moving nonrelativistic point charge e through a hole of radius a in an infinite, ideally conducting plane is obtained. The technique of solution involves a quasistatic approximation to the dynamic problem in the regime $\beta \ll 1$. In this limit, the presence of the hole is found to induce an array of slowly accelerating linear multipoles whose associated radiation leads to a finite energy loss proportional to β^3. An interpolation formula $E_R = e^2\gamma\beta^3/a$ for the energy loss valid for arbitrary β is constructed from this result and the known ultrarelativistic expression. Application of this formula in conjunction with the relativistic Maxwellian allows computation of a temperature dependent, radiation loss expression appropriate to the passage of a relativistic pulse through an iris-type aperture. A formula incorporating finite beam length coherence effects for the radiation loss in low energy particle accelerators is also developed. (auth)

31018 DIFFRACTION OF ELECTRONS BY TWO AND THREE MUTUALLY ORTHOGONAL STANDING LIGHT WAVES. Ehlotzky, F. (Innsbruck Univ.). Can. J. Phys.; 53: No. 2, 157-164(15 Jan 1975).

The one-dimensional problem of electron scattering by a standing light wave, known as the Kapitza–Dirac effect, is shown to be easily extendable to two and three dimensions, thus showing all characteristics of diffraction of electrons by simple two- and three-dimensional rectangular lattices. (auth)

31019 SOME CONSIDERATIONS ABOUT e^+-e^- ($\bar{p}-p$) INTERACTIONS, MUON-ELECTRON UNIVERSALITY, AND STRANGENESS SCHEME FOR LEPTONS. Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 12: No. 5, 129-132(1 Feb 1975).

The properties of the lepton and hadron interactions are compared, and the lepton model is studied: the following points are emphasized: the experimental results for e^+e^- and $\bar{p}-p$ collisions seem to suggest the existence of a certain similarity between the properties of the two kinds of interactions, the so-called muon–electron universality may correspond to the $\Lambda-N$ universality in the theory of SU(3), and lepton interactions can be described fairly well by introducing a quantum number corresponding to the strangeness in the hadron family. (auth)

31020 PROPAGATION OF NUCLEONS IN LASER FIELDS. Becker, W. (Univ., Tuebingen, Ger.). J. Phys., A (London); 8: No. 2, 160-170(Feb 1975).

The propagator of a spin ½ Dirac particle with an anomalous magnetic moment in an external plane wave field is calculated by means of an off-shell eigenfunction expansion. The intensity-dependent frequency shift in Compton scattering is derived, and the modifications due to the anomalous magnetic moment are found to be nonnegligible. Except in the case of a linearly polarized laser beam, there is moreover an intensity-dependent zeroth order harmonic of very low frequency, which is specific for the anomalous magnetic moment. (auth)

31021 CLASSICAL ELECTRON MASS RENORMALIZATION. Tabensky, R.; Villarroel, D. (Univ. Chile, Santiago). Lett. Nuovo Cim.; 12: No. 4, 125-127(25 Jan 1975).

The exceptional character of the orthogonal hyperfine $\sigma(\tau)$ defining P_μ^a, where P_μ^a is defined as $\int T_{\mu\nu}^b\, d\sigma^\nu$, where $\sigma(\tau,\mu)$ is a spacelike hyperplane that cuts the electron world line at $z_\mu(\tau)$ and is orthogonal to a given timelike vector μ_μ. It is shown that unless μ_μ coincides with ν_μ, mass renormalization is not possible. (JFP)

31022 DIRECT LEPTON–HADRON COUPLING AND ELECTRON PAIR ANNIHILATION INTO MUONS. Janson, M. M.; Swanson, J. R. (Johns Hopkins Univ., Baltimore). Lett. Nuovo Cim.; 12: No. 4, 117-121(25 Jan 1975).

It is pointed out that should a direct coupling between leptons and hadrons exist, it would modify the cross section for purely leptonic processes as well. In particular unless $\mu-e$ universality is violated one should obtain observable deviations from quantum electrodynamics in the process $e^+e^- \to \mu^+\mu^-$. The differential cross sections are calculated for $e^+e^- \to \mu^+\mu^-$ including all five possible couplings S, P, V, A, and T. It is assumed that the anomalous interactions of leptons are parity conserving. It is found that a forward–backward asymmetry persists only in the case of axial coupling even if the polarization of the final muons is not observed. (JFP)

31023 COHERENT PION PHOTOPRODUCTION FROM DEUTERON. Lazard, C. (Institut de Physique Nucleaire, Orsay, France); Petroff, P.; Lombard, R. J.; Maric, Z. Lett. Nuovo Cim.; 12: No. 10, 379-384(8 Mar 1975).

The reaction $\gamma + d \to \pi^0 + d$ is studied with account of contributions of the impulse terms as well as simple pion rescattering terms. Also calculations neglecting nuclear Fermi motion and off-shell effects and subsequently the corrections due to Fermi motion in the impulse approximation are considered. The differential cross sections and angular distributions are considered. (JFP)

31024 SPIN CORRECTIONS TO EIKONAL APPROXIMATION. Leger, D.; Levy, M. (Laboratoire de Physique Theorique, Paris). Nuovo Cim.; 25A: No. 1, 53-74(1 Jan 1975).

In the framework of the eikonal approximation one computes the spin corrections to the bound states of a spin-½ particle in a Coulomb potential. One first considers the case of scattering in a Yukawa potential $V(r) = -Z\alpha\ (\exp[-\mu r])/r$ in the limit where $\mu \to 0$. The correct treatment of the Coulomb potential is given using off-shell eikonal scattering amplitudes. (auth)

31025 HIGH-ENERGY BEHAVIOR OF A CURRENT AMPLITUDE AND THE CALLAN–SYMANZIK EQUATIONS. Nash, C. Nuovo Cim.; 25A: No. 1, 173-180(1 Jan 1975).

The Callan–Symanzik equations are used to study the high energy behavior of the current amplitudes for the vector-meson Compton scattering. The singularity in coordinate space that this behavior induces in the bilocal operator of the light-cone algebra. (auth)

31026 INTEGRAL EQUALITIES WITH DAMPING FUNCTION FOR π MESON ELECTROMAGNETIC FORM FACTOR. Agranovskii, B. A. (Inst. of Theoretical Physics, Uzhgorod, USSR). Yadern. Fiz.; 20: No. 5, 1041-1050(Nov 1974). (In Russian).

The dispersion relations with damping function for the π meson electromagnetic form factor are obtained. They are also valid for the exponential growth of the form factor and result in the practically finite-energy integral representations for the pion electromagnetic radius. A number of integral sum rules for the form factor are obtained. (auth)

Weak

Refer also to abstracts 30909, 31341, and 31587.

31027 TRANSPORT COEFFICIENTS OF A NEUTRINO GAS. de Groot, S. R.; van Leeuwen, W. A.; Meltzer, P. H. (Univ. of Amsterdam). Nuovo Cim.; 25A: No. 2, 229-251(21 Jan 1975).

A relativistic kinetic theory for massless particles is developed in which expressions for the transport coefficients in terms of the cross section are found. Applied to a neutrino gas of temperature T one obtains for the heat conductivity λ and the shear viscosity η the expressions $\lambda = 5(10)^{57}T^{-2}$ and $\eta = 9(3)10^{35}T^{-1}$ (cgs units). The volume viscosity vanishes. (auth)

31028 COMMENTS ON WEAK NEUTRAL VECTOR MESONS AND CHARGE ASYMMETRY IN $e^+e^- \to \mu^+\mu^-$. Chen, M.; Yao, Y. (Physics Department, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. Lett. 34: No. 10, 628-630 (10 Mar 1975).

We comment on the forward–backward asymmetry in the reaction $e^+e^- \to \mu^+\mu^-$ due to the possible existence of parity–nonconserving

weak neutral interactions. Estimates are given for the possibilities that such an interaction is mediated either by a very massive vector boson or by the recently discovered J(3105) or ψ (3695) particles. (auth)

31029 ARE THE NEW PARTICLES COLOR GLUONS? Pati, J.C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Salam, A. Phys. Rev. Lett. 34: No. 10, 613-616 (10 Mar 1975).

We explore the possibility that the new particles ψ and ψ' are color gluons and propose characteristic tests of such a possibility. (auth)

31030 CHIRAL CONFIGURATION MIXING AND DEEP–INELASTIC SCATTERING OF POLARIZED LEPTONS BY POLARIZED NUCLEONS. Le Yaouanc, A.; Oliver, L.; Pene, O.; Raynal, J.C. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France).

In the quark model, a large SU(3) ⊗ SU(3) configuration mixing appears at $P_z = \infty$ as a relativistic effect due to the high internal velocities for quarks inside hadrons. This mixing describes the relative alignment between the nucleon helicity and the helicities of the quarks. Since the quark–parton model is understood in a frame where the nucleon has a large momentum, we propose to take into account this large mixing in the calculation of the spin–dependent effects in deep–inelastic scattering of a polarized lepton (electron or muon) by a polarized nucleon. The scaling of the spatial wave function is ensured by the Lorentz contraction. Unlike a previous quark–parton model calculation by Gourdin we take into account the configuration mixing in the estimation of the singlet contribution to the asymmetries. We express our results in terms of the SU(3) ⊗ SU(3) mixing parameters. Assuming that the nucleon is a superposition of irreducible SU(3) ⊗ SU(3) representations allowed by the quark model, we can express the singlet contribution in terms of the F, D couplings of the low-lying octet axial-vector matrix elements. The neutron asymmetry appears to be proportional to the deviation of F/D from the SU(6) value 2/3. As expected, the Bjorken sum rule for the difference between the proton and neutron asymmetries is satisfied. In our specific model, where the spin part of the wave function is at rest is expressed in terms of free Dirac spinors, we have $F/D = 2/3$, so that we predict a large positive proton asymmetry and a null asymmetry for the neutron, $A^p = 1/3|GA/GV|$, $A^n = 0$. (auth)

31031 SIGNATURES OF NEUTRAL CURRENTS AND HEAVY LEPTONS IN WEAK INELASTIC PROCESSES. Soni, A. (Institute for Theoretical Physics, State University of New York, Stony Brook, Long Island, New York 11794). Phys. Rev. D 11: No. 3, 624-632 (1 Feb 1975).

The signatures of various neutrino–induced inelastic reactions are theoretically analyzed. With the aim of differentiating "muonless" reactions which proceed via neutral currents from those via an intermediate heavy lepton, we derive expressions for their differential cross sections, including all polarization effects due to the heavy lepton. Similarly, reactions involving charged leptons in the final state are also discussed. A simple parameterization for the hadronic structure functions is used for a numerical comparison of various differential spectra. For the hadronic decay channels of the heavy lepton the vertex is phenomenologically related to $e^+e^- \rightarrow$ hadrons and the observed constancy of the cross section for the latter process is incorporated. Finally, expressions for the differential spectra in the limit of vanishing transverse momenta of the final lepton or hadron state are related to the total production cross section of heavy leptons, and characteristic difference in such spectra for reactions with and without heavy leptons is pointed out and explained on the basis of a simple theorem on the decay of polarized spin–1/2 particles via a general $(aV + bA)$ leptonic current. (auth)

31032 TOTAL ν AND $\bar{\nu}$ CROSS SECTIONS AND INELASTIC PROCESSES. Franzinetti, C. (Turin Univ. (Italy). Instituto di Fisica). pp 353-367 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F.R. Germany, 27–31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 10 refs.

The experiments at CERN and NAL for the study of the high-energy behavior of the neutrino interactions both on nucleons and electrons are discussed. The relevant details of the beam and detectors are summarized. A theoretical interpretation of the experimental results. Lower limits for the mass of the $W^{\pm}$ are given. (BRH)

31033 QUASI-ELASTIC NEUTRINO REACTIONS: FORM FACTORS. Derrick, M. (Argonne National Lab., Ill. (USA)). pp 369-388 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F. R. Germany, 27–31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F.R. Germany (27 Aug 1973). 26 refs.

The experimental situation on two-body neutrino reactions is summarized. Three reactions that have been the subject of recent experiments are discussed: $\nu n \rightarrow \nu^- p$, $\bar{\nu} p \rightarrow \nu^+ \Lambda$ and $\nu p \rightarrow \nu^- \Delta^{++}$. In all cases data are discussed with particular reference to its bearing on the determination of the axial vector form factor. (BRH)

31034 NOTE ON THE K_{l3}–DECAY PARAMETERS AND INELASTIC EFFECTS. Bhamathi, G.; Raghavan, S. (Univ. of Madras). Lett. Nuovo Cim.; 12: No. 6, 183-188(8 Feb 1975).

In order to determine whether the bound on the K_{l3} decay parameters can be improved by taking into account the inelastic effects of the $K\pi$ scattering amplitude, a simple extension of a previous approach is made to include inelastic effects. The bound on the absolute value of the slope of the scalar form factor at $t = 0$ is obtained. (JFP)

31035 TRANSPORT COEFFICIENTS OF A GAS OF NEUTRINOS. Van Leeuwen, W. A.; Meltzer, P. H.; De Groot, S. R. (Amsterdam Univ. (Netherlands). Instituut voor Theoretische Fysica). Compt. Rend., Ser. A, B; 279: No. 3, 45-46(15 Jul 1974). (In French).

The thermal conductivity and viscosities of a gas of neutrinos are calculated using the relativistic transport equation of Lichnerowicz and Marrot, which generalizes the classical Boltzmann equation. (FR)

31036 WEAK MESON DECAYS IN A QUARK CURRENT × CURRENT PICTURE WITH SYMMETRY BREAKING. Flamm, D. (Univ., Vienna); Kielanowski, P.; Guillen, J. S. Nuovo Cim.; 25A: No. 1, 16-28(1 Jan 1975).

Starting from the Cabibbo weak current in the framework of the relativistic quark model an effective current is deduced. It includes SU_3 breaking via the quark mass differences. The following decays are considered: $K \rightarrow \mu\nu$, $\pi^+ \rightarrow \pi^0 e\nu$, $K \rightarrow \pi\mu\nu$, $K^+ \rightarrow \pi^+\pi^0$ and $K_S^0 \rightarrow 2\pi$. The computations are parameter-free and agreement with experiment is achieved. (auth)

31037 SOME PROCESSES WITH NONCONSERVATION OF LEPTONS. Shchepkin, M. G. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 5, 1005-1015 (Nov 1974). (In Russian).

The model proposed by Gribov and Pontecorvo is used to calculate the probabilities of the processes $\mu^- + Z \rightarrow (Z-2) + e^+$, $K^+ \rightarrow \pi^- e^+ \mu^+$ allowed by the Machmud–Konopinsky scheme and the probability of muon → antimuon oscillations. The model makes it possible to treat in a unified way the results of the experimental check of the lepton conservation law. The comparison of the upper limits of the constants characterizing the degree of lepton nonconservation shows that in the framework of the chosen model the search for the decays $K^+ \rightarrow \pi^- e^+ \mu^+$ and $K^+ \rightarrow \pi^- \mu^+ \mu^+$ can be a critical check of the lepton conservation law. (auth)

31038 TEST OF RENORMALIZABLE MODELS OF WEAK INTERACTIONS IN e^+e^- COLLISIONS. Sushkov, O. P.; Flambaum, V. V.; Khriplovich, I. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 20: No. 5, 1016-1023(Nov 1974). (In Russian).

In framework of the Weinberg and Georgy–Glashow models the cross sections are calculated for the processes $e^+e^- \rightarrow \mu^+\mu^-$ (in particular, near the Z resonance), $e^+e^- \rightarrow Z\gamma$, $e^+e^- \rightarrow W^+W^-$, $e^+e^- \rightarrow e^+e^-W^+W^-$. Two latter cross sections became equal at the energies $2E \approx 14 m_W$. (auth)

31039 SPIN EFFECTS IN MUON ELASTIC SCATTERING ON A NUCLEUS. Flambaum, V. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 20: No. 5, 1024-1028(Nov 19 1974). (In Russian).

An expression which allows one to calculate spin effects is obtained for the amplitude of the muon elastic scattering on a heavy nucleus. The results can be used for small scattering angles. The momentum transfer can be comparable to the inverse nuclear radius, i.e., the nucleus is not assumed to be point-like. (auth)

31040 VIOLATION OF THE $\Delta T = 1/2$ RULE AND PION INTERACTION IN THE $K \rightarrow 3\pi$ DECAY. Volkovitskii, P. E. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 5, 988-994(Nov 1974). (In Russian).

Formulas are obtained for the isotopic amplitudes of the $K \rightarrow 3\pi$ decays. A consequence is that the three-pion states with isospin 2 do not contribute to the spectra slopes nor to the spectra in the center of the Dalitz plot. The magnitude of the $\Delta T = 3/2$ transitions is estimated. The branching ratio $\Gamma(K_S^0 \rightarrow \pi^+\pi^-\pi^0)/\Gamma(K_L^0 \rightarrow \pi^+\pi^-\pi^0)$, due to the CP conserving weak interaction, is determined. For mulas are presented for the isotopic amplitudes taking the final-state interactions into account up to the fourth-order terms in the pion relative momenta. (auth)

Strong (General)

Refer also to abstracts 30847, 31130, and 31131.

31041 (JINR-E2-8584) ELECTROMAGNETIC EFFECTS IN DIFFRACTION SCATTERING OF HADRONS. Frankfurt, L. L.; Khoze, V. A.; Kopeliovich, B. Z.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 16p. Dep. NTIS (US Sales Only) $4.00.

The role of electromagnetic effects in diffraction processes is discussed in cases of strong and weak Pomeron interaction. The estimates of electromagnetic corrections to the vacuum pole intercept and to the triple-Pomeron coupling constant are carried out. (auth)

31042 (JINR-E2-8586) EMPIRICAL MASS RATIO OF HADRONS. Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 11p. Dep. NTIS (US Sales Only) $4.00.

The following empirical relation between masses in the baryon octet is presented: $m_p : m_\Lambda : m_\Sigma = 1 : \sqrt[4]{2} : \sqrt[3]{2} : \sqrt{2}$. (auth)

31043 CURRENT ALGEBRA: REAL QUARKS AND POINCARE INVARIANCE. Celeghini, E. (Univ., Florence); Lusanna, L.; Sorace, E. Nuovo Cim.; 25A: No. 2, 331-352(21 Jan 1975).

It is shown that the difference between statics (i.e., the classification group) and dynamics (i.e., "current algebra") of elementary particles is related to the nonpointlike structure of hadrons. Using the $q\text{-}\bar{q}$ model of mesons one can derive from the behavior of the inner structure under the Poincaré group the transformation between the so-called constituent and current algebras as a purely kinematical consequence of factorizing the center-of-mass motion and of boosting to P infinite. An explicit model is then proposed using the harmonic-oscillator potential. (auth)

31044 GEOMETRICAL MODEL FOR NONHADRONS AND ITS IMPLICATIONS FOR HADRONS. Casalbuoni, R. (Istituto Nazionale di Fisica Nucleare, Florence); Longhi, G. Nuovo Cim.; 25A: No. 3, 482-502(1 Feb 1975).

With the aid of the ideas suggested by the string model, the possibility of describing nonhadrons by a geometrical approach is studied. It is shown how it is possible to construct a Lagrangian which contains a fundamental length, by selecting a class of motions of the string. The quantization of the model gives rise to a spin tower of zero-mass particles. The interaction among these states is realized in analogy with the theory of Mandelstam for the interacting strings. The vertices for the lower spin states are studied in some detail. It is shown that in order to get the correct electromagnetic and gravitational interactions the fundamental length $\sqrt{\alpha'}$ must be of the order of 10^{-33} cm. This choice of $\sqrt{\alpha'}$ gives a very great value for the three-scalar coupling constant. This fact allows some speculation on the possibility to interpret these scalars as the constituents of the hadrons. (auth)

31045 SCALING AND REGGE BEHAVIOR IN HADRON SCATTERING. Freund, P. G. O.; Nandi, S. (Univ. of Chicago). Nuovo Cim.; 25A: No. 3, 395-408(1 Feb 1974).

Requiring the compatibility of scaling and Regge behavior in the kinematic region in which they both apply, and certain analyticity properties, one obtains in the context of the quark model a simple expression for the angular distribution of high energy scattering. This expression is found to agree with experiment. (auth)

31046 CLUSTER PRODUCTION AND THE MUELLER–REGGE MODEL. Horn, D.; Moshe, M.; Nussinov, S. (Department of Physics and Astronomy, Tel–Aviv University, Ramat–Aviv, Tel–Aviv, Israel). Phys. Rev. D 11: No. 3, 677-679 (1 Feb 1975).

We show that no finite Mueller–Regge model (MRM) of clusters is equivalent to any MRM of their decay products. In particular, independent cluster production calls for only non–negative correlations, whereas we prove that in any nontrivial MRM the numbers of both negative and positive asymptotic correlations are infinite. The proofs are obtained by an investigation of the "pressure" in these models. (auth)

31047 THE PHYSICAL LADDERS AND RELATIVISTIC GENERALIZATIONS. Nikolov, A. (Department of Physics, University of Sofia, Sofia, Bulgaria). Ann. Phys. (N.Y.) 89: No. 1, 181-192 (Jan 1975).

The research on the relativization of the hadron classification scheme connected with the U (6,6) ladders is continued. For this purpose the semidirect product U (6,6) · T (143) and its Lie algebra are used. A representation of U (6,6) · T (143) is built; with its help the generalized momenta and the generalized angular momenta are introduced. By means of their combinations with the ladder momenta a representation of the mentioned algebra is built; this representation gives a possibility for the relativization of the considered scheme to be carried out. Finally, it is asserted that the correspondent hadron classification is relativistically invariant. (auth)

31048 SINGLE–PARTICLE CONTRIBUTIONS TO CERTAIN CLASSES OF ALGEBRAIC SUM RULES. Golowich, E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 11: No. 3, 589-601 (1 Feb 1975).

Phenomenological and theoretical aspects of single–particle contributions to sum rules derived from commutation relations are considered. A derivation of sum rules arising from an equal–time axial–charge algebra evaluated between arbitrary single–particle states is given. A phenomenological analysis of these sum rules is carried out. An analogous derivation of sum rules associated with the sigma operator is shown to be invalid. An amended form for the sum rules is derived. Finally, we comment on relations obtained by taking vacuum–vacuum or vacuum–single–particle matrix elements of certain commutators. (auth)

31049 ANALYTIC REPRESENTATION OF THE SIX-POINT FUNCTION AND INCLUSIVE PROCESSES. Dahmen, H. D. (Abteilung fuer Physik, Gesamthochschule Siegen, Germany); Konetschny, W. (European Organization for Nuclear Research, Geneva (Switzerland)); Steiner, F. (Hamburg Univ. (F.R. Germany). 2. Inst. fuer Theoretische Physik). Nucl. Phys., B; 86: No. 1, 104-124(3 Feb 1975).

A new representation is proposed for the N-point retarded function defined as the Fourier transform of the matrix element between incoming states of the R product of two operators. Locality, crossing and normal cut structure in the invariant variables containing the Fourier vector are correctly incorporated in this representation and an explicit expression for the spectral function can be given. The case N = 6 is discussed in detail and structure functions for deep inelastic as well as purely hadronic inclusive processes are obtained from the representation. (auth)

31050 CAN PIONS BE THE DOMINANT LINKAGE IN MULTIPERIPHERAL CLUSTER MODELS. Tan, C. I.; Tow, D. M. (Brown Univ., Providence, R. I. (USA). Dept. of Physics). Phys. Lett., B; 53: No. 5, 452-456(6 Jan 1975).

The consequence of pion-pole dominance in multiperipheral cluster models is investigated. It is shown that the observed size of hadronic total cross sections and the observed average multiplicities are incompatible with the premise that the dominant high energy production is the repeated-pion-exchange in a multiperipheral cluster chain. Implications of these findings are discussed and comments made on various alternatives for the search of a realistic multiperipheral cluster model. (auth)

31051 SHRINKING OF THE FORWARD DIFFRACTION PEAK AND MULTIPARTICLE PRODUCTION. Krzywicki, A. (Paris-11 Univ., 91–Orsay (France). Lab. de Physique Theorique et Particules Elementaires). Nucl. Phys., B; 86: No. 2, 296-308 (10 Feb 1975).

It is shown, that independently of any specific model for multiparticle production, the shrinking with energy of the forward diffraction peak can be derived assuming local compensation (in rapidity space) of the transverse components of momenta of secondaries. A formalism suitable for this demonstration is developed and a lower bound for the "pomeron slope" is derived. This bound, which involves observable parameters only, is valid under fairly general conditions. Finally, simple experiments which can test the validity of the ideas presented in this paper are suggested. (auth)

31052 WHAT CAN WE LEARN FROM SEMI-INCLUSIVE RAPIDITY CORRELATIONS. Hayot, F.; Le Bellac, M. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Nucl. Phys., B; 86: No. 2, 333-345(10 Feb 1975).

A general formulation of semi-inclusive two-particle rapidity correlations is studied for short-range models. It is used to compare with the 205 GeV NAL Bubble Chamber data different decay distributions for independently emitted clusters. Non-independent cluster production and semi-inclusive correlations between charged and neutral particles are also commented upon. (auth)

31053 FERMI GOLDEN RULE. Fonda, L. (International Centre for Theoretical Physics, Trieste, Italy); Ghirardi, G. C.; Rimini, A. Nuovo Cim.; 25A: No. 4, 537-548(21 Feb 1975).

The derivation of the Fermi golden rule for the transition rates of an unstable system is reconsidered within a recently proposed theoretical framework to describe decay processes. It is shown that the obtained transition rates contain a dominant term which coincides with the standard result, plus correction terms whose features are discussed. (auth)

31054 PERTINENCE OF THE SEMI-GROUP LAW IN THE THEORY OF THE DECAY OF AN UNSTABLE ELEMENTARY

PARTICLE. Ali, S. T. (International Centre for Theoretical Physics, Triete, Italy); Fonda, L.; Ghirardi, G. C. Nuovo Cim.; 25A: No. 1, 134-148(1 Jan 1975).

The problem of the decay of an unstable elementary particle is analyzed from the point of view of a quantum-mechanical theory of randomly repeated measurements. A semi-group law of evolution, on the space of all density matrices, is shown to result. This situation is contrasted with some earlier work on the problem where a semi-group law of evolution on a Hilbert space of state vectors was postulated. Many of the difficulties of this older theory are naturally resolved within the context of the currently proposed theory. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 31735.

31055 (DESY-74/64) J(3.1), ψ(3.7) – HOW ABOUT COLOR? Krammer, M.; Schildknecht, D.; Steiner, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Dec 1974. 26p. Dep. NTIS (US Sales Only) $4.50.

The new particles J(3.1) and ψ(3.7) are interpreted as colored ω and ϕ mesons, respectively. By relating the radiative decay $J(3.1) \to \eta\gamma$ to 2γ decays of the color singlet mesons π^0, η, x^0, it is found that the radiative decay $J(3.1) \to \eta\gamma$ is suppressed (in contrast to simple expectations from $\omega \to \pi^0\gamma$). Via "strong new duality" the recurrences J' (4.18 ± 0.08), J'' (5.03 ± 0.13), ... and ψ' (4.63 ± 0.08), ψ'' (5.41 ± 0.13), ... are predicted. (auth)

31056 (JINR-P2-8576) REMARKS ON ψ PARTICLES. Bilen'kii, S. M.; Pontekorvo, B. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 10p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Possible connection between ψ-particles and weak interaction is discussed. An experiment is proposed to check whether there exists the neutrino channel of decay of ψ (3105). (auth)

31057 MODEL OF PION CONDENSATION. Blaha, S. (Cornell Univ., Ithaca, NY). Nuovo Cim.; 25A: No. 2, 252-258 (21 Jan 1975).

Conditions for pion condensation are stated which are based on well known instabilities towards spontaneous break-down in indefinite-metric quantum field theories. Then a dipole-ghost mechanism for condensation is discussed. A phenomenological model is described in which condensation could occur at 0.08 fm^{-3} via this mechanism. (auth)

31058 ZERO-CONTOURS IN LOW-ENERGY K-π SCATTERING. Arnodo, A. (Univ., Nice). Nuovo Cim.; 25A: No. 3, 511-533(1 Feb 1975).

The paths of zeros of the low energy K-π scattering amplitudes $A^{I_t=\frac{1}{2}}$ and $A^{I_t=1}$ are examined in a simple K* and ρ dominance model, where it is found that the roles of PCAC zero, K* and ρ Legendre zero, and double-pole-killing zero are played by the same zero-contour in the (s, t, u)-plane, an ellipse for the first amplitude, an ellipse plus the line s = u for the second one. The behavior of these zero-contours in the u-channel physical region is studied in comparison with the experimental zeros determined from the $K^+\pi^- \to K^+\pi^-$ and $K^+\pi^0 \to K^0\pi^+$ scattering results, and it is found that up to the K* mass region the elliptic contour of $A^{I_t=\frac{1}{2}}$ is essentially unaffected by unitarity, whilst the elliptic contour of $A^{I_t=1}$ is slightly more sensitive to such constraints. A comparison with the behavior of the zeros of the corresponding π-π amplitudes $A^{I_s=2}_{I_u}$ and $A^{I_s=1}_{I_u}$ is also performed. (auth)

31059 ARE THERE NARROW D-WAVE BARYON-ANTIBARYON RESONANCES? Dürr, H. P. (Max-Planck-Institut für Physik und Astrophysik, München, Germany). Phys. Rev. Lett. 34: No. 10, 616-619 (10 Mar 1975).

The conjecture of a possible narrow D-wave resonance of the $\Omega\bar{\Omega}$ system is extended to general baryon-antibaryon systems. On the basis of the well-known NN forces one finds that $B\bar{B}$ systems bound by pion forces are more likely to produce narrow resonances. In particular, one may expect narrow resonances below the $N\bar{N}$, $\Lambda\bar{\Lambda}$, and perhaps even the $\Xi\bar{\Xi}$ thresholds. A narrow $B\bar{B}$ resonance may serve in a second step (similar to the α particle) to explain the narrow ψ and ψ'. (auth)

31060 SUM RULES FOR INVERSE $\pi\pi$ SCATTERING AMPLITUDES. Common, A. K. (Univ. of Kent, Canterbury, New Zealand); Pennington, M. R. Nuovo Cim.; 25A: No. 2, 219-228 (21 Jan 1975).

Sum rules based on crossing symmetry, analyticity and positivity are derived for the inverse of $\pi\pi$ scattering amplitudes. Their importance lies in the fact that, unlike such sum rules for the amplitude itself, these for the inverse impose constraints on the s- and p-wave amplitudes. The results of testing recent phenomenological solutions to Roy's equations with the $\pi^0\pi^0$ sum rules are given. (auth)

31061 TOOL FOR EXTENDING THE ANALYTICITY DOMAIN OF PARTIAL-WAVE AMPLITUDES AND THE VALIDITY OF ROY-TYPE EQUATIONS. Auberson, G.; Epele, L. (CEN de Saclay, Gif-sur-Yvette, France). Nuovo Cim.; 25A: No. 3, 453-466(1 Feb 1975).

A theorem for analytic completion involving families of algebraic manifolds is presented. As an application it is shown that the validity domain of Roy-type equations for pion-pion scattering can be extended to the range $-28m_\pi^2 < s < 164.7m_\pi^2$, on the basis of axiomatic analyticity. The same method applies to the enlargement of the holomorphy domain of partial-wave amplitudes. (auth)

31062 THEORY OF PION PRODUCTION. Ballestrero, A. (International Center for Theoretical Physics, Trieste, Italy); Fonda, L.; Predazzi, E.; Ghirardi, G. C. Nuovo Cim.; 25A: No. 3, 438-446(1 Feb 1975).

A new time-dependent theory for pion production in nucleon-nucleon collisions is presented in which each production process is interpreted as a random "measurement" suffered by the nucleon-nucleon system. The approach has the advantage of being defined in a perfectly consistent way from a quantum-mechanical point of view. The obtained results have a remarkable resemblance with those obtained from other models of high energy production. (auth)

31063 PHENOMENOLOGICAL ANALYSIS OF TOTAL CROSS-SECTION MEASUREMENTS AT THE FERMI NATIONAL ACCELERATOR LABORATORY. Hendrick, R.E.; Langacker, P.; Lautrup, B.E.; Orfanidis, S.J.; Rittenberg, V. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 11: No. 3, 536-554 (1 Feb 1975).

The available high-energy total-cross section data for π^*, K^*, p, and $\bar{p}$ scattering on protons and deuterons are analysed. It is found that the diffractive (nonfalling) components of the cross sections are compatible with several different functional forms for the energy dependence, including one in which σ_{K^+p}, σ_{π^+p} and σ_{pp} will rise asymptotically as ln$s$ with coefficients in the ratios predicted by SU(3) and the naive quark model. The falling components of the cross sections are found to be in agreement with Regge theory. The ρ and ω intercepts are found to be $\alpha_\rho = 0.57$ and $\alpha_\omega = 0.43$. A comparison with forward nondiffractive cross sections verifies the Regge pole phase of the ω but suggests a possible breaking of the ρ pole phase. The data are in strong agreement with universality, are compatible with exchange degeneracy between the f and ω, and indicate a substantial breaking of SU(3). Glauber screening corrections, with inelastic contributions added, are calculated and used to predict the total cross sections for scattering on deuterium. The predictions are in excellent agreement with the data. (auth)

31064 REAL PARTS OF THE FORWARD ELASTIC π^*p, K^*p, $\bar{p}p$, AND pp SCATTERING AMPLITUDES FROM 1 TO 200 GeV/c. Hendrick, R.E.; Lautrup, B. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 11: No. 3, 529-535 (1 Feb 1975).

The recently measured total cross section data from the Fermi National Accelerator Laboratory are used to calculate the real parts of the forward scattering amplitude for π^*p, K^*p, $\bar{p}p$, and pp reactions from 1 to 200 GeV/c. The real parts and their uncertainties are calculated using dispersion relations which include subtraction constants, pole terms, and unphysical-cut contributions. A comparison to experiment shows the proton-proton real part measurements to be in excellent agreement with dispersion-relation results, while experiments show disagreement with the calculated π^-p and K^*p real parts over at least a portion of the energy range where measurements exist. (auth)

31065 DISPERSION RELATIONS FOR THE WEINBERG π-π — AMPLITUDES. Franklin, J. (Department of Physics, Temple University, Philadelphia, Pennsylvania 19122). Phys. Rev. D 11: No. 3, 513-516 (1 Feb 1975).

Symmetrized, forward dispersion relations with good convergence properties are used to provide a unitary extrapolation of the Weinberg (current algebra) amplitudes to the physical low-energy region. The extrapolated phase shifts tend to agree with experiment up to about 550 MeV. The dispersion integral unitarization increases Weinberg's $I = 0$ scattering length from 0.21 to 0.24. We show that attempts to extrapolate data from above 400 MeV down to threshold using the effective-range formula lead to spurious (high) estimates of the Weinberg scattering lengths. A true test of the Weinberg hypothesis would require consistent data around 325 MeV. (auth)

31066 UPDATED EVALUATION OF THE $\rho\pi\pi$ REGGE RESIDUE FUNCTION. Tryon, E.P. (Department of Physics and Astronomy, Hunter College of the City University of New York, New York, New York 10021). Phys. Rev. D 11: No. 3, 698-702 (1 Feb 1975).

The $\rho\pi\pi$ Regge residue function is extracted from the recent $\pi\pi$ data of Hyams *et al.* and Durusoy *et al.*, for $-1.0 \leq t \leq 0.1$ GeV^2, with uncertainties of the order of 15% near $t = 0$. Comparison is made

with an earlier result based on the data of Carroll *et al.* Finally, a discussion is given of the content of a sum rule used in the analysis. (auth)

31067 SOME INFORMATION FROM NUCLEON–ANTINUCLEON ANNIHILATION AT REST: e^+e^- ANNIHILATION, HADRONIC FRAGMENTATION AND DEEP INELASTIC STRUCTURE FUNCTIONS. Pelaquier, E. (Montpellier-2 Univ., 34 (France). Dept. de Physique Mathematique). Nucl. Phys., B; 86: No. 2, 270-284(10 Feb 1975).

The experimental spectra of charged pions in $\bar{N}N$ annihilation at rest are described in a model of quasi-two-body decays. The same model predicts the π^0, ρ and ω spectra. A previous calculation is applied to determine in the vector dominance model, the pions spectra in e^+e^- annihilation at the same energy. The $\bar{N}N$ system is then used as a heavy hadron in order to describe, in a model-independent way: (i) the projectile fragmentation part in inclusive reactions; (ii) the valence part of the deep inelastic structure function. (auth)

31068 VECTOR—MESON DOMINANCE AND THE $\psi(3105)$ AND $\psi(3700)$ MESONS. Alles, W. (Univ., Bologna). Lett. Nuovo Cim.; 12: No. 6, 175-179(8 Feb 1975).

The discussion of $\psi(3105)$ and $\psi(3700)$ decay in the vector dominance model includes the branching ratios and SU(3) breaking. Also the production and decay of other members of the (1^-, 8^-) multiplet are considered. (JFP)

31069 HAVE DISPERSION RELATIONS FOR THE FORWARD pp, $\bar{p}p$ SCATTERING AMPLITUDE REALLY BEEN TESTED. Dumbrajs, O. V.; Staszel, M. (Joint Inst. for Nuclear Research, Dubna). Lett. Nuovo Cim.; 12: No. 4, 122-124(25 Jan 1975).

The weakness of the claim that the dispersion relations were tested for the forward pp and $\bar{p}p$ scattering is discussed. The reasons are given as being the arbitrary choice of the way in which the large unphysical region and the low energy $\bar{p}p$ scattering region is taken into account in the calculations, the arbitrary choice of the method of extrapolation of the differential cross sections to the forward direction in the experimental determination of the real part of the amplitude, and the presence of the three nonvanishing amplitudes in the forward nucleon–nucleon scattering. (JFP)

31070 COMMENTS ON THE LEPTONIC COUPLINGS OF THE $\psi(3.1$ GeV) RESONANCE. Etim, E.; Grillo, A. F.; Pancheri-Srivastava, G.; Srivastava, Y. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 12: No. 9, 281-284(1 Mar 1975).

An attempt is made to bound $\Gamma_{\mu^+\mu^-}$ from the $g-2$ for the muon and $\Gamma_{\nu\bar{\nu}}$ from the available $e\nu$ data in order to shed light on the peculiarities of the resonance width of the ψ (3105). Also the problem of interference effects in the e^+e^- channel is discussed. (JFP)

31071 HAN–NAMBU MODEL AND $\psi(3105)$ AND $\psi(3695)$ MESONS. Alles, W. (Univ., Bologna). Lett. Nuovo Cim.; 12: No. 9, 285-289(1 Mar 1975).

Since there were some drawbacks to the Han–Nambu model for the $\psi(3105)$ and $\psi(3695)$ mesons an attractive model is built that has a more symmetric SU(3) × SU(3) breaking, terms that transform like the eight components of an octet of SU(3), $(8_a, 1)$ and of an octet of SU(3), $(1, 8_a)$; and that has a built-in mechanism that depresses radiative decays of ψ mesons. (JFP)

31072 REMARKS CONCERNING THE e^+e^- RESONANCE AT 3.1 GeV. Bailin, D.; Jones, D. R. T.; Love, A. (Univ. of Sussex, Engl.). Lett. Nuovo Cim.; 12: No. 10, 375-378(8 Mar 1975).

The possibility is considered that the very narrow resonance seen in e^+e^- annihilation at 3.1 GeV may be an electromagnetically produced color octet state which is prevented from undergoing strong decays by an exact color SU(3) symmetry, there being no color octet mesons of lower mass. The model is the model of Han–Nambu type. (JFP)

31073 INFRA-RED FINITE NORMAL-PRODUCT FORMALISM. Gomes, M.; Koeberle, R. (Univ., Sao Paulo, Brazil). Nuovo Cim.; 25A: No. 4, 616-628(21 Feb 1975).

An infrared finite normal-product formalism is set up by subtracting Feynman integrands at some spacelike point $p = \eta$, $\eta^2 = -\mu^2$. It is shown how the usual machinery, like equations of motion, Zimmermann identities, Callan-Symanzik and renormalization group equations, works. As an application the Ward identity for a charged scalar boson. (auth)

31074 EFFECT OF VECTOR QUANTUM EMISSION IN MESON RESONANCE DECAY. Honda, K.; Iwata, K.; Matsuda, Y.; Murota, T. (Hokkaido Univ., Sapporo). Lett. Nuovo Cim.; 12: No. 11, 413-417(15 Mar 1975).

The static approximation is used in the naive realistic quark model to propose another description of vector quantum emission in meson resonance decay. The idea is carried out by using the transition amplitude constructed from the quark current. The amplitude and width of $B \to \omega\pi$ decay are explained using this model. Various meson resonance decay widths are found. (JFP)

31075 WHAT A DOMINATING RHO AND WEAK EXOTICS CAN DO FOR $\pi\pi$ SCATTERING NEAR THRESHOLD. Pennington, M. R. (Rutherford Laboratory, Berkshire, Eng.). Nuovo Cim.; 25A: No. 1, 149-164(1 Jan 1975).

It is shown in $\pi\pi$ scattering, that ρ-dominance of the I = 1 absorptive part, together with the weakness of exotic channels, allows one to deduce, without any detailed knowledge of the I = 0 $\pi\pi$ amplitude, phenomenologically well satisfied relations between threshold $\pi\pi$ parameters. In particular, the "universal curve" of Morgan and Shaw, the quasi-linearity of subthreshold s-wave amplitudes is reproduced, and the size of p- and d-wave amplitudes is determined. (auth)

31076 pp AND $\bar{p}p$ ELASTIC SCATTERING INCLUDING SPIN. Majerotto, W. (Oesterreichischen Akademie der Wissenschaften, Vienna). Nuovo Cim.; 25A: No. 1, 117-133(1 Jan 1975).

The pp and $\bar{p}p$ elastic scattering at high energies is discussed in a picture which is a natural extension of the idea of Chou and Yang to include spin, energy dependence, and a real part of the diffractive amplitude. The main interest is to study the polarization in the range $p_{lab} \sim$ (30 to 200) GeV/c which is or will be available at NAL and the SPS at CERN. A discussion in terms of helicity amplitudes is given. (auth)

31077 PION FORM FACTOR AND POSSIBLE BEHAVIOR OF THE $\pi\pi$ SCATTERING PHASE δ_1^1 IN THE ELASTIC REGION. Suleimanov, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 5, 1029-1034(Nov 1974). (In Russian).

The limitations on a possible behavior of the $\pi\pi$ scattering phase δ_1^1 in the elastic region were obtained by comparing the strict dispersion inequalities and experimental values of the modulus of the electromagnetic pion form factor $|F_\pi(t)|$ at small time-like t. (auth)

31078 SINGLE PRODUCTION OF K MESONS IN πN COLLISIONS NEAR THRESHOLD. Malakyan, Yu. P. (Inst. of Physical Research, Erevan). Yadern. Fiz.; 20: No. 5, 995-1004(Nov 1974). (In Russian).

Assuming the partial conservation of strangeness changing axial vector current it is possible to estimate the total cross sections and polarization effects of single K meson production in $\pi N \to KN$ reaction near threshold. The accuracy of this hypothesis is discussed. The cross sections turn to be of the order of $\sigma_{tot} \sim 10^{-38}$ to 10^{-39} cm^2 i.e., more than an order higher than the production cross sections of single hyperons in the reactions $\pi N \to \pi Y$. In some cases such a strong increase is due to a large contribution from the Λ^* (1405) resonance. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 30952, 30964, and 31123.

31079 (JINR-E2-8527) ABOUT SPIN PARITY OF A $p\omega$-ENHANCEMENT NEAR 1800 MeV. Lednicky, R. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 14p. Dep. NTIS (US Sales Only) $4.00.

Recently a threshold $p\omega$ enhancement at 1800 MeV was observed in several reactions of the type $ap \to ap\omega$ claimed to be probably an s-wave object with the spin $J = 1/2$ or $3/2$. Studies show that this enhancement has spin parity $3/2^-$ and that, in the production process $ap \to ap\omega$, the t-channel helicity is approximately conserved. (auth)

31080 (KFKI-74-78) STOCHASTIC PROCESSES AND MULTIHADRON PRODUCTION. Montvay, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Nov 1974. 15p. (CONF-741090-1). Dep. NTIS (US Sales Only) $4.00.

From symposium on particle physics; Kuhlungsborn, F. R. Germany (Oct 1974).

Statistical multihadron production models are considered in a stochastic framework. The predictions of the stochastic quark model of hadron clusters are reviewed. (auth)

31081 AMBIGUITIES IN THE ANALYSIS OF $\pi N \to \pi\pi N$. Donohue, J. T.; Leroyer, Y. (Univ., Bordeaux). Nuovo Cim.; 25A: No. 3, 409-418(1 Feb 1974).

For the reaction $\pi N \to \pi\pi N$ measured on an unpolarized target, there exists a ten-parameter family of transformations of the helicity amplitudes which preserves the six observable quantities. These transformations consist of a nine-parameter family, easily expressed in terms of two-dimensional matrices, which specify the orientation of the amplitudes in a four-dimensional space, and a one-parameter family which changes the relative

amount of S- and P-wave production. The consequences of this ambiguity for some recent analyses of π-π are discussed. (auth)

31082 STRUCTURE OF THE RHO-SINGULARITY IN A MULTICLUSTER MODEL. Garcia, A.; Masperi, L.; Parga, N. (Universidad Nacional de Cuyo, Bariloche, Argentina). Nuovo Cim.; 25A: No. 3, 377-394(1 Feb 1974).

A multicluster model was constructed for πN_{CEX} amplitude in the forward direction which, in contrast to conventional ρ-Regge models, reproduces within error bars the data for $\sigma^{tot}_{\pi^- p} - \sigma^{tot}_{\pi^+ p}$ and $d\sigma_{CEX}/dt|_{t=0}$ for $3 \leq p_{lab} \leq 60$ GeV/c and fairly agrees with preliminary Batavia results. The model for the imaginary part shows an oscillation around a traditional ρ-pole value due to the onset of one large rapidity gap intermediate states. It is proposed that this oscillation, which fits well into Serpukhov enhancement, is the counter-part of similar threshold effects in $\sigma^{tot}_{\pi N}$ and σ^{tot}_{NN} arising at much higher energies. Absorptive corrections between clusters are considered to add consistency to the model. (auth)

31083 STATISTICAL DESCRIPTION OF THE ENERGY DEPENDENCE OF NONEXCHANGE PROCESSES. Eilam, G. (Physics Department, McGill University, Montreal, Quebec, Canada). Phys. Rev. D 11: No. 3, 586-588 (1 Feb 1975).

Motivated by recent unexpected results on $(d\sigma/dt)(\pi^- p \to K^+\Sigma^-)$ at 0°, we suggest that a statistical picture describes the high-energy as well as the low-energy s dependence of processes without t-channel exchange. A flattening (break) of slope in the fixed-angle s dependence is predicted at the same value of s for all nonexchange reactions with the same incoming channel. In particular, all nonexchange $\pi^- p \to c + d$, $K^- p \to c + d$ reactions will exhibit a break at $s \simeq 7-8$ GeV^2, $s \geq 10$ GeV^2, respectively. Some further predictions are also discussed. (auth)

31084 SPIN AND PARITY OF THE DIFFRACTIVELY PRODUCED Nπ SYSTEM FROM ITS INTERFERENCE WITH THE Δ(1236) ISOBAR. Ochs, W.; Davidson, V.; Dzierba, A.; Firestone, A.; Ford, W.; Gomez, R.; Nagy, F.; Peck, C.; Rosenfeld, C. (California Inst. of Tech., Pasadena (USA)); Ballam, J. Nucl. Phys., B; 86: No. 2, 253-269(10 Feb 1975).

An isospin and partial-wave analysis is performed of the low-mass Nπ system in $\pi N \to \pi(N\pi)$ using new data at 14 GeV/c in the interval $0.02 < t_{\pi\pi} < 0.5$ GeV^2. The diffractive background is studied by means of its interference with the Δ and it is found that a considerable fraction of this background has spin-parity $1/2^-$ and does not obey the Gribov-Morrison rule. Using a model for Δ production the helicity amplitudes for diffractive production and their phases can be estimated. (auth)

31085 MOMENTUM TRANSFER SLOPE VARIATION IN DIFFRACTIVE DISSOCIATION. Lubatti, H. J.; Moriyasu, K. (Univ. of Washington, Seattle). Lett. Nuovo Cim.; 12: No. 4, 97-100(25 Jan 1975).

It was shown that the reciprocal relation between slope and mass in diffractive dissociation can be understood in terms of a very simple model of the hadron internal structure. When analyzed by using the variable $M^2 - m_1^2$, the slopes are linear in $1/(M^2 - m_1^2)$ independent of the incident particle. It is also pointed out that the form of the internal wave function used is scale invariant depending only on the ratio of physical quantities. The reactions studied are $\pi N \to (3\pi)N$, $KN \to (K\pi\pi)N$, $\pi N \to \pi(N\pi)$, $KN \to K(N\pi)$, and $NN \to N(N\pi)$. (JFP)

31086 CORRELATIONS BETWEEN PARTICLES IN DIFFERENT FRAGMENTATION REGIONS. Donohue, J. T. (Bordeaux-1 Univ., 33 - Talence (France). Lab. de Physique Theorique). pp 51-63 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21-23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

The hypothesis of the short-range order (SRO) in inclusive reactions is discussed for $p + p \to 1 + 2 + X$ (1 and 2 being pions to exclude single diffraction). The question to answer is to what extent the two-particle cross section should factorize, and in which direction any non-factorizing effect should go. The usual form of the two-particle cross section in the two fireball model is considered. It is shown in which sense the energy-momentum and angular-momentum conservation may be expected to influence factorization. Calculations indicate that even after single diffraction events are excluded, some corrections to the SRO hypothesis may arise from double diffraction processes. Results concerning deviations from factorization are presented in terms of the two-particle cross section as a function of the lab. rapidity; some were calculated using the anisotropic correlated fireball decay. (FR)

31087 PHENOMENOLOGICAL REGULARITY IN ELECTRO-EXCITATION OF RESONANCES. Nagai, H.; Shiga, K. (Kyushu Univ., Fukuoka). Lett. Nuovo Cim.; 12: No. 10, 351-355(8 Mar 1975).

Following previous work the analysis of the total photoabsorption cross sections of the nonleading resonances is given, and a search is made for the phenomenological regularity in the inelastic-electroexcitation mechanism of various resonances. The analysis of the total photoabsorption cross sections at W = 1.420, 1.615, 1.820, and 1.920 GeV. (JFP)

31088 DUAL DESCRIPTION OF THE REACTIONS $K^\pm p \to K^{*0}\pi^\pm p$ FOR INCIDENT MOMENTA FROM 2.7 TO 12.7 GeV/c. Tenner, A. G.; Versteeg, M. F.; Wolters, G. F. (Univ., Amsterdam). Nuovo Cim.; 25A: No. 4, 657-687(21 Feb 1975).

A model is considered in which the reactions $K^\pm p \to K^{*0}\pi^\pm p$ are simultaneously described in terms of a dual five-point function for p-wave exchanges plus dual-resonance amplitudes for pion exchange and pomeron exchange. Various versions of the model are considered. A convenient parametrization of the imaginary parts of Regge trajectories is introduced. Four free parameters are adapted to obtain good agreement with a vast amount of experimental data, containing effective-mass and four-momentum transfer distributions. These cover the incident-momentum interval from 2.7 to 12.7 GeV/c, and were subjected to a variety of kinematical cuts in the different experiments which are taken into account in the analysis. Total cross-sections and their composition in terms of contributions of the various amplitudes are predicted. The Q-bump is reproduced out of K*(1420), diffraction dissociation of the K-meson (Q(1300)) and also nondiffractive pion exchange background. The L-bump is shown to be particularly sensitive to interference between pomeron exchange and the remaining part of the amplitude. (auth)

31089 PHASES OF RESONANT AMPLITUDES AND UNDERSTANDING OF LOCAL DUALITY IN $\pi N \to \pi\Delta$. Gustafson, G. (Univ. of Lund, Sweden). Lett. Nuovo Cim.; No. 11, 421-424 (15 Mar 1975).

It is shown that for some of the amplitudes the phases of the resonant $\pi N \to \pi\Delta$ amplitudes obtained in phase shift analyses can be determined from the forces due to exchanged particles. In the model it is assumed that the dominant force in the reaction $\pi\Delta \to \pi\Delta$ is given by ρ exchange. (JFP)

31090 STRUCTURE OF THE πN SCATTERING AMPLITUDE. Eremyan, Sh. S. (Inst. of Physics, Erevan). Yadern. Fiz.; 20: No. 5, 1051-1062(Nov 1974). (In Russian).

The πN scattering amplitudes at the energies of 6, 10, and 16 GeV in the momentum transfer range from 0 to 1.0 (GeV/c)^2 are calculated based on the experimental data on differential cross sections, polarizations and spin correlation parameters in the elastic πp scattering and the $\pi^- p \to \pi^0 n$ charge exchange reaction. The vacuum amplitudes obtained from the analysis are approximated by means of the "quasi-eikonal" model. It is shown that the resulting isovector amplitudes cannot be described in framework of the usual absorptive Regge models. (auth)

31091 LOGARITHMICAL SUM RULES IN CONNECTION WITH THE FINITE ENERGY SUM RULES. Zamiralov, V. S. (Moscow State Univ.). Yadern. Fiz.; 20: No. 5, 1035-1040(Nov 1974). (In Russian).

Dispersion sum rules for the logarithmical πN elastic scattering amplitudes are proposed. Those sum rules can be related to usual ones due to the smallness of the exchange reaction as compared to elastic scattering. This fact allows one to construct the logarithmical sum rules with a strongly suppressed contribution from zero values of the amplitudes. The sum rules are valid with a good accuracy. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 31332.

31092 (CEA-CONF-2857) BREAK-UP OF THE DEUTERON IN THE REACTION d + D → n + P + d. Cocu, F.; Ambrosino, G.; Guerreau, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). [nd]. 2p. (In French). (CONF-740822-12). Dep. NTIS (US Sales Only) $4.00.

From conference on few-body problems in nuclear and particle physics; Quebec, Canada (27 Aug 1974).

In order to study the quasi-free scattering mechanism in the d + d → n + p + d reaction at low energies a series of measurements was performed for incident deuterons in the energy range 6.7 to 11.7 MeV by steps of 1 MeV and a couple of detection angles $\Theta_p = \Theta_d = 19°,5$ and $\Theta_n = -30°$. (auth)

31093 (ITF-74-118P) PROBLEM OF $\pi\alpha$ SCATTERING IN THE FRAMEWORK OF THE FADDEEV EQUATIONS. Kopaleish-

vili, T. I.; Machavariani, A. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The Faddeev equations for the scattering of an arbitrary (but different from nucleon) particle by a deuteron are written in the representation of the total moment and isospin of a system taking into account the nucleon identity. In this basis the expressions for the elastic scattering cross sections and the scattering with the deuteron decay are obtained. Assuming the potentials of NN and πN interactions to be separable one obtains the set of one-dimensional equations for the πα scattering problem. As an example of application of the results obtained the πα scattering length is calculated taking into account pair interactions only in the S-states. It is shown that the value of the πα scattering length is essentially dependent upon the fact whether the interaction contains repulsion at small distances or not. (auth)

31094 (NP-20362) NUCLEON–NUCLEON INTERACTION. Lectures Given at the Niels Bohr Institute and NORDITA, Copenhagen. Part II. Brown, G. E.; Jackson, A. D. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). 1974. 288p.

The topics discussed include scattering equations and nucleon form factors, one-boson-exchange contributions to the nucleon–nucleon interaction, and the two-pion exchange interaction. (JFP)

31095 PHENOMENOLOGICAL FIT OF THE NP CHARGE EXCHANGE CROSS-SECTION AT INTERMEDIATE AND HIGH ENERGY. Bizard, G. (Laboratoire de Physique Corpusculaire, Caen, France); Diu, B. Nuovo Cim.; 25A: No. 3, 467-481(1 Feb 1975).

The experimental data concerning the np charge exchange cross section (especially two new sets covering the intermediate-energy region (1 to 2) GeV/c and the high energy region (10 to 27) GeV/c) are fitted in a model-independent way; with two reasonable hypotheses, it turns out to be possible to determine the values of the 5 amplitudes at each energy (π exchange having been taken into account explicitly). The fits are good and give quite striking values for the parameters: 2 out of the 3 amplitudes contributing in the forward direction are unappreciable, the third one being equal to the πN coupling constant; the other two amplitudes are far from negligible, especially one which has to be quite large in order to solve the "hump problem." On the other hand, the values found remain remarkably independent of energy, in a domain where s varies between 5 and 50 $(GeV)^2$, so that a $\sqrt{s}$ or even a log s dependence would easily be detected. (auth)

31096 COMPOSITE–PARTICLE DUAL–MODEL PHENOMENOLOGY. Arik, M. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. D 11: No. 3, 602-604 (1 Feb 1975).

A fit to the leading meson recurrences and to the proton–proton, proton–antiproton total cross–section difference is obtained using a dual four–point function which has composite particle properties and which has previously been successful in fitting large–angle proton–proton scattering data. Physical implications of the fit are discussed, an estimate of the quark–gluon coupling constant is made, and a phenomenologically useful form of the four–point function is obtained. (auth)

31097 PARITY–VIOLATING ASYMMETRY IN NUCLEON–NUCLEON SCATTERING AT HIGHER ENERGIES. Henley, E.M.; Krejs, F.R. (Physics Department, University of Washington, Seattle, Washington 98195). Phys. Rev. D 11: No. 3, 605-610 (1 Feb 1975).

The parity–violating asymmetry of the total cross section for the scattering of longitudinally polarized nucleons from unpolarized proton targets is calculated for energies of 300 MeV–20 GeV. One–pion, ρ, and ω exchanges are included in the computation of the weak force between nucleons. Below energies of roughly 1 GeV, the Watson theorem is adapted to compute the asymmetry. At higher energies an absorptive model is used to take into account hadronic distortion effects. (auth)

31098 BARYON–ANTIBARYON FINAL–STATE INTERACTIONS AND MULTIPERIPHERAL THRESHOLD EFFECTS. Jones, S.T. (Department of Physics and Astronomy, University of Alabama, University, Alabama 35486 and Department of Physics, University of Illinois, Urbana, Illinois 61801). Phys. Rev. D 11: No. 3, 692-695 (1 Feb 1975).

We investigate baryon–antibaryon contributions to the *pp* total cross section, using simple models. We find that the $B\bar{B}$ threshold is lower than needed to explain the rise in σ_{pp}, if final–state interactions are important. (auth)

31099 THE PERIPHERAL IMPACT PARAMETER DESCRIPTION OF INELASTIC DIFFRACTION DISSOCIATION AT VERY HIGH ENERGIES. Humble, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 86: No. 2, 285-295(10 Feb 1975).

A simple peripheral impact parameter model for inelastic diffraction dissociation is used to describe both the very high energy exclusive process $pp \to p\pi^+n$ and the inclusive process $pp \to pX$. It is found that the width of the impact parameter profile has a small dependence on s/M^2 which is compatible with a Regge shrinkage factor of the form $(s/M^2)^{\rho \cdot 17t}$. It is suggested that the profile is independent of the number of particles produced, and that the nonvanishing of the triple pomeron coupling and the sharp t-behavior of the inclusive distributions at small M^2 values is the generalization of the slope-mass correlation effect observed in exclusive processes. (auth)

31100 HIGH-ENERGY HADRON–HADRON COLLISIONS AND INTERNAL HADRON STRUCTURE. Van Hove, L. (European Organization for Nuclear Research, Geneva (Switzerland)); Pokorski, S. (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). Nucl. Phys., B; 86: No. 2, 243-252(10 Feb 1975).

As shown by many authors, central particle emission in pp collisions at centre-of-mass energies $\gtrsim 20$ GeV can be described in terms of independent cluster production. In a previous paper this process has been related to the quark-gluon picture of nucleon structure. The present paper carries this relation further and links the leading particle spectrum of non-diffractive hadron-hadron collisions to the χ distributions of quarks in the hadron. Thus, the flat leading particle spectrum, as observed in non-diffractive pp collisions, is found to be naturally related to the steeply falling χ distribution of quarks in the nucleon, as deduced from the structure functions measured in deep inelastic scattering of electrons and neutrinos on nucleons. The analysis is extended to meson-nucleon collisions and leads to a prediction of the general shape of the quark χ distribution in a meson. (auth)

31101 MULTIPLICITY DISTRIBUTION AT 10^4 GeV AND THE TWO-COMPONENT MODELS. Chaudhary, B. S.; Malhotra, P. K. (Tata Inst. of Fundamental Research, Bombay (India)). Nucl. Phys., B; 86: No. 2, 360-364(10 Feb 1975).

The multiplicity distribution in pp collisions at 10^4 GeV is presented and compared with the predictions of the two-component models. It is concluded that the data seem to rule out all those models which predict a dip in the multiplicity distribution at this energy. The data indicate that within the framework of two-component models the average multiplicity of the "diffractive" component must also grow with energy so as to avoid the appearance of a bimodal multiplicity distribution at 10^4 GeV. (auth)

31102 EMPIRICAL FRAGMENTATION DISTRIBUTION AND ITS IMPLICATIONS BASED ON AN INDEPENDENT CLUSTER EMISSION MODEL. Chiu, C. B.; Ugaz, E. (Texas Univ., Austin (USA). Center for Particle Theory). Nucl. Phys., B; 86: No. 1, 153-174(3 Feb 1975).

Multiparticle production in high-energy pp collisions is studied from the point of view of an independent cluster emission model which as far as this work is concerned, can also be viewed as a simple modification of the Chew-Pignotti model. The main points are as follows. (i) The π^-, K^- and $\bar{p}$ inclusive y-distributions are approximately described by a common shape. In particular, besides the dominance of triple-Regge behavior near the physical boundary, an empirical fixed-power extrapolation of the triple-Regge formula approximately described the distribution in the fragmentation region, which then smoothly joins onto the plateau region. (ii) The average multiplicities in the energy region near threshold have the behavior $[\ln(s/s_{th})]^{1-2\alpha}$ $B \sim \ln^3(s/s_{th})$, which is governed by the same empirical extrapolation. (iii) Based on an independent cluster emission model and the empirical inclusive distribution, a reasonable simultaneous description to the σ_T, $\langle n \rangle$ and σ_n versus n data is obtained. (auth)

31103 FORWARD AND LARGE-ANGLE MECHANISMS IN HIGH-ENERGY HADRON SCATTERING FOR NUCLEI. Malecki, A. (CNEN, Rome); Picchi, P.; Dymarz, R. Lett. Nuovo Cim.; 12: No. 4, 101-106(25 Jan 1975).

A model is presented for high energy hadron scattering from nuclei which includes the two basic mechanisms of the multiple collisions: that all scatterings from target subunits are near forward in direction, hence the projectile trajectory is almost rectilinear, one scattering from a subunit occurs at a large angle; such a violent event may be associated with a number of forward scatterings on the remaining subunits along the initial and final projectile direction. The elastic cross section is presented for p – ^{4}He scattering at 1 GeV calculated in various models of multiple scattering. (JFP)

31104 CLUSTER-ORIENTED APPROACH TO MULTIPARTICLE PRODUCTION. Krzywicki, A. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique Theorique et Particules Elementaires). pp 13-38 of Colloquium on Hadronic Physics at ISR Energy, Marseille, November 21–23, 1973. Soffer, J. (ed.). Marseille, France; Centre National de la Recherche Scientifique, Centre de Physique Theorique ([nd]).

From colloquium on hadronic physics at ISR energy; Marseille, France (21 Nov 1973).

The usefulness of the cluster-oriented approach to multiparticle production—the one where attention is focused on the characteristic features of the structure of individual events—is illustrated with three examples. The first example concerns a candidate for an important law which specifically applies to the structure of the individual events: the local compensation of charges in rapidity space. The second example shows how a simple hypothesis about the structure of individual events can lead to a dynamical model: the bootstrap model of inclusive spectra. Finally, a recent cluster-oriented ISR experiment by the Pisa-Stony Brook team is discussed. (FR)

31105 POLARIZATION ANALYSIS IN THE SCATTERING OF SPIN ½ PARTICLES ON SPIN 1 PARTICLES. Lambacher, H. (Institut fuer Hochenergiephysik, Vienna); Urban, P. Acta Phys. Austr.; 38: No. 2, 101-112(1973). (In German).

The polarization of the deuteron is considered. Equations are derived describing the polarization vector and the polarization tensor. (JSR)

31106 FOUR-NUCLEON PROBLEM IN TERMS OF THE HILBERT-SCHMIDT RESONANCE SCATTERING. Norodetskii, I. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 5, 1063-1077(Nov 1974). (In Russian).

The integral equations for four-particle amplitudes are written in terms of the scattering amplitudes of Hilbert-Schmidt resonances corresponding to the subsidiary 3,1 and 2,2 subsystems. Then the four-nucleon problem takes the form of the two-particle multichannel problem. A simple diagram technique which is a generation of a usual three-dimensional nonrelativistic technique is introduced. The relation of the scattering amplitudes of resonances to two-particle amplitudes is obtained. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 31029 and 31133.

31107 (ITF-74-169P) IRREDUCIBLE REPRESENTATIONS OF THE CONFORMAL GROUP. II. Sufficient Conditions for the Irreducibility of Nonunitary Principal Series. Golod, P. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 11p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The sufficient conditions for irreducibility of non-unitary principal series representations are proved. Irreducible representations of the conformal group, and sufficient conditions for the irreducibility of nonunitary principal series are treated. (auth)

31108 (ITP-74-142E) RELATIONS BETWEEN VARIOUS QUANTITIES OF WIGNER-RACAH CALCULUS OF DIFFERENT COMPACT LIE GROUPS. Alisauskas, S. J. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The relations between isofactors, recoupling matrices, and reduction scheme transformation matrices of the unitary, orthogonal, and symplectic groups in the case of the semicanonical or canonical bases are considered. The isofactors and recoupling matrices of U_n are proved to be proportional. The boundary cases of the quantities under consideration of O_n or Sp_{2k} are found equal to those of U_n. The isofactors of the orthogonal groups are found to be analytical continuation of those of the symplectic groups and inversely. The relations and identities between the Wigner-Racah quantities of the Lie groups of different rank are pointed out. (auth)

31109 d_2-TYPE REPRESENTATION OF THE CONFORMAL GROUP EXTENDED BY REFLECTIONS. Iwaki, A.; Szegoe, K. (Central Research Inst. for Physics, Budapest). Nuovo Cim.; 25A: No. 2, 207-218(21 Jan 1975).

The d_2-type representation of the conformal group is examined. The explicit basis functions of the irreducible spaces are calculated, and one has an invariant bilinear functional for them. The representation is extended to include reflections as well, and the representation of the extended group is examined. (auth)

31110 ALGEBRAIC IDENTITIES AMONG U(n) INFINITESIMAL GENERATORS. Okubo, S. (Univ. of Rochester, NY). J. Math. Phys. (N. Y.); 16: No. 3, 528-535(Mar 1975).

Some algebraic identities among infinitesimal generators of the n-dimensional unitary group U(n) were found. They satisfy a simple quadratic equation for degenerate representations. A generalization of Holstein-Primakoff boson realization for the U(n) group is also given. (auth)

31111 ON DYNAMICAL SYMMETRY BREAKDOWN. Ioffe, B. L.; Novikov, V. A.; Shifman, M. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Phys. Lett., B; 53: No. 5, 467-470(6 Jan 1975).

The possibility of dynamical symmetry breaking, that is the appearance of $\langle\phi\rangle \neq 0$ due to radiative corrections in scalar theory with the interaction $\lambda\phi^4$, scalar electrodynamics and non-Abelian gauge theories is investigated. It is shown that in the one-loop approximation at small coupling constant the dynamical symmetry breaking is absent and the only mechanism of spontaneous symmetry breaking remains the Goldstone-Higgs-Kibble effect. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 31000, 31028, 31030, 31359, and 31605.

31112 LEFT-RIGHT GAUGE SYMMETRY AND AN "ISOCONJUGATE" MODEL OF *CP* VIOLATION. Mohapatra, R.N.; Pati, J.C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 11: No. 3, 566-571 (1 Feb 1975).

Left-right symmetry in the starting gauge interactions provides the basis for an "isoconjugate" model of *CP* violation with the consequence that $\eta_{+-} = \eta_{00}$. The magnitude of *CP* violation is naturally suppressed at least to the extent that $V + A$ interactions are suppressed in nature compared to the $V-A$ interactions. This allows the possibility that intrinsic *CP*-violating phase (arising through spontaneous symmetry breaking, for example) may have a maximal character, which may reveal itself at intermediate high energies to possibly disappear at still higher energies. *CP* violation in leptonic, semileptonic, and $\Delta Y = 0$ parity-violating nonleptonic interactions [which could contribute to the electric dipole moment of the neutron (edm)] arise on the one hand in fourth order of the weak gauge interactions and on the other via Yukawa interactions between fermions and leftover Higgs mesons as well as via $W_L - W_R$ mixing. The magnitude of the latter contributions may be limited to be less than or of order $G_F \times 10^{-4}$ in order that the experimentally observed relation $\eta_{+-} = \eta_{00}$ may hold at least to a few percent. Thus the electric dipole moment of the neutron d_n is expected to be less than or of order 10^{-24} *e* cm. *CP* violation in all $|\Delta S| = 1$ nonleptonic decays ($Y \to N + \pi$, etc.) should, in general, have the same order of magnitude as $|\eta_{+-}|$. (auth)

31113 SPACE-TIME INTERNAL ALGEBRA DESCRIBING THE HADRONIC MASS SPECTRUM. Basri, S.A. (Department of Physics, Technion-Israel Institute of Technology, Haifa, Israel); Horwitz, L.P. Phys. Rev. D 11: No. 3, 572-579 (1 Feb 1975).

A Lie algebra containing both the Poincaré and SU(6) algebras as subalgebras is abstracted from Clifford algebra generated by seven elements. In a state in which the internal-symmetry quantum numbers are definite, the mass has a continuous spectrum peaked about certain values, and may be discrete in a few special states. An exact formula for the average squared mass is obtained which contains the Gell-Mann-Okubo expression in a natural way, and which also includes terms that correctly split the mass within isospin multiplets. (auth)

31114 SU(3) TRACE IDENTITIES AND THE CALCULATION OF EFFECTIVE COUPLINGS IN A BARYON-LOOP MODEL OF WEAK RADIATIVE KAON DECAYS. Rockmore, R. (Physics Department, Rutgers, The State University, New Brunswick, New Jersey 08903). Phys. Rev. D 11: No. 3, 620-623 (1 Feb 1975).

A simple algorithm for the recursive reduction of the trace of a product of any number of the *f* and *d* matrices of SU(3) is given. SU(3) trace identities (through fourth order) are used to construct effective interaction Lagrangians in the baryon-loop model for *PVV*, *PV*γ, and weak (strangeness-changing) *PV*γ couplings. At the same time it is shown that the effects of baryon-mass breaking on the *PVV* coupling are negligible in the loop model. The usefulness of this formal compaction is further illustrated in the calculation of the contributions of all vector-meson poles to $K_2^0 \to \pi^+\pi^-\gamma$ decay. It is found that the previous neglect of the contribution of K^* poles in this case is justified. (auth)

31115 MIRROR SYMMETRY, HEAVY LEPTONS, AND SCALAR BOSONS IN THE SU(2) ⊗ U(1) MODEL OF EMW INTERACTIONS. Lipmanov, E. M. (Yaroslavl State Univ., USSR). Yadern. Fiz.; 20: No. 5, 976-983(Nov 1974). (In Russian).

Assumption on the mirror symmetry of the Lagrangian of lepton interactions with vector and scalar fields is discussed in framework of the SU(2) ⊗ U(1) model of the electromagnetic-weak interactions with the spontaneously broken gauge symmetry. A system of possible variants of the SU(2) ⊗ U(1) model, based on the γ_5 classification of the fundamental lepton states is investigated. It is

shown that with the requirement of the mirror symmetry in all cases there is an essential rise of possible experimental effects of the lepton scalar interactions. (auth)

Applications (Strong)

Refer also to abstracts 31047 and 31390.

31116 (ITP-74-172E) LOW-ENERGY πN-SCATTERING IN CHIRAL DYNAMICS WITH THE USE OF SUPERPROPAGATORS. Gaisak, M. I.; Lend'el, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 21p. Dep. NTIS (U. S. Sales Only) $4.25.

S- and p-waves of πN-scattering are obtained in higher orders of a nonlinear chiral Lagrangian in Gursey's model. One-loop diagrams are calculated with the use of the superpropagator method of regularization. Both the energy dependence of s- and p-waves and the position of singularities of the partial amplitudes are in agreement with the experimental data. The number of adjustable parameters is reduced to one. (auth)

31117 3105 MeV VECTOR MESON AND SU_4 BREAKING. Marcolungo, P. (Univ., Padua). Lett. Nuovo Cim.; 12: No. 10, 356-358(8 Mar 1975).

The new neutral vector meson at a mass M = 3105 MeV raises a problem due to its small rates of decay into hadrons and comparable decay rate into leptons. The two most probable solutions are either to assign this new particle to a set of 15 + 1 vector mesons of a charmed SU(4) group as a singlet ϕ_c or to consider it as a vector meson W_0 which mediates weak interactions. The foundation of a previous numerical estimate which leads to the choice of the second solution and is based on an approximate calculation of the expected ϕ_c width which results in 1 to 10 MeV or more. It is concluded that the hypothesis that the 3105 MeV vector meson is the ϕ_c is not ruled out but more exhaustive data and discussion are needed. (JFP)

31118 BROKEN CHIRAL SYMMETRY AND NEUTRAL SCALAR MESON. Bogomol'nyi, E. B. (Moscow Physical-Technical Inst.). Yadern. Fiz.; 20: No. 5, 984-987(Nov 1974). (In Russian).

The probabilities of production of a neutral scalar meson appearing due to the spontaneous symmetry breaking in the models of weak and electromagnetic interactions are calculated. Under the assumption that the meson interacts with the symmetry violating term it is shown that the K decay data contradict the existence of such a meson with its mass $m_\varphi < m_K - m_\pi$. (auth)

Scattering Theory

Refer also to abstracts 30894, 30993, 31680, and 31722.

31119 (ITF-74-121P) GENERAL KINEMATIC PROPERTIES OF THREE-BODY REACTIONS. Baz, A. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The simple general formulas of multichannel scattering theory with the two-particle channels are generalized for the case of the presence of three-body channels. The general properties of the two- and three-body amplitudes following from the Hamiltonian hermiticity are studied. (auth)

31120 (RL-74-149) REGGE PARAMETERS FROM DUALITY AND UNITARITY. Chan Hong-Mo; Paton, J. E.; Tsou Sheung Tsun; Ng Sing Wai. (Science Research Council, Chilton (UK). Rutherford Lab.). Feb 1975. 43p. Dep. NTIS (US Sales Only) $5.25.

From s-channel unitarity, two coupled integral equations are derived for the reggeon and Pomeron propagators using a method developed earlier. The first (R) is a consistency equation constraining the reggeon parameters, while the second (P) gives the Pomeron trajectory in terms of the solutions of the first. Starting then from the empirical information on the reggeon intercept ($\alpha_R \sim .5$) and the t-dependence of the triple-reggeon vertex obtained in inclusive reactions, one is able to calculate the strength of reggeon couplings g and the parameters of the Pomeron by solving these equations. Two approximate solutions are given, one asymptotically and one at finite energies. The first gives $g = 8.6$, $\alpha_p(0) = 1.12$ and $\alpha_p'(0) = .1$ GeV^{-2} while the second gives $g = 7.0$, $\alpha_p(0) = .95$ and $\alpha_p'(0) = .5$ GeV^{-2}. These are to be compared with the empirical values $g \sim 6.3$, $\alpha_p(0) \sim 1.0$ and $\alpha_p'(0) \sim .25$ GeV^{-2}. In addition, one predicts the relative normalization of the Pomeron and reggeon propagators at t = 0 to be P/R = 1.0 which is quite close to the values between .9 and 1.2 obtained from phenomenological fits to σ_T. The Pomeron pole is generated as the shadow of amplitudes which are dominated by the multiperipheral production of resonant clusters. A crude estimate with this solution yields at NAL-ISR energies an average charge multiplicity of about 2.3 per cluster as compared with the value of 2.2 ± 0.2 obtained from a recent experiment. (auth)

31121 (RL-75-012) REAL PART OF A GEOMETRICAL POMERON. Dias de Deus, J. (Science Research Council, Chilton (UK). Rutherford Lab.). Jan 1975. 19p. (T-105). Dep. NTIS (US Sales Only) $4.00.

It is shown that geometrical scaling for the Pomeron implies the following fixed s t-derivative analyticity relation: $ReF(s,t)/ReF(s,o) = \partial/\partial t\,\{t[ImF(s,t)/ImF(s,o)]\}$. Applications of this relation are discussed. In particular it is obtained that: the slope parameter of ReF(s,t) at t = o is the double of the slope parameter of ImF(s,t), ReF(s,t) must have a zero around $t \simeq 0.2$, and the real part of the Pomeron has a peripheral structure in the impact parameter plane. (auth)

31122 SCATTERING IN TWO-DIMENSIONAL MODEL WITH LAGRANGIAN $L = (1/\gamma)[(1/2)(\partial_\mu u)^2 + m^2(\cos u - 1)]$. Aref'eva, I.Ya.; Korepin, V.E. (Leningrad Division, Mathematics Institute, USSR Academy of Sciences). JETP Lett. 20: No. 10, 312-314 (20 Nov 1974).

It is shown that the fundamental scattering properties of the classical solutions of the equation $\Box u + m^2 \sin u = 0$ are preserved also in the quantum case. (auth)

31123 SCATTERING AMPLITUDE REPRESENTATION IN THE COMPLEX IMPACT-PARAMETER PLANE. Paccanoni, F. (Univ., Padua). Nuovo Cim.; 25A: No. 2, 289-302(21 Jan 1975).

Starting from a parametrization of the scattering amplitude in terms of the variable K tg $\theta/2$, the analyticity properties of the Bessel-transformed amplitude are analyzed. It is shown that, at high energies, the approach is equivalent to the impact-parameter description. The choice of the new variable, however, allows one to derive an integral representation for the scattering amplitude in the complex impact-parameter plane, founded only on basic properties of the partial-wave expansion. Also some applications to the phenomenology of inelastic two-body reactions are discussed. (auth)

31124 VARIATIONAL METHODS FOR BOUND-STATE PROBLEMS. Singh, S. R.; Stauffer, A. D. (York Univ., Downsview, Ont.). Nuovo Cim., B; 25B: No. 2, 547-556(11 Feb 1975).

Two variational methods were formulated for bound-state problems, analogous to the Schwinger and the Kohn methods in scattering theory, in a unified manner. The latter is equivalent to the Rayleigh-Ritz method. They are shown to yield a convergent process to determine the eigenvalues and eigenvectors for a large class of potentials. (auth)

31125 CONFIGURATION SPACE CONSTRAINTS AS PROJECTORS IN THE MANY-BODY SYSTEM. Do Amaral, C. M. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., B; 25B: No. 2, 817-828(11 Feb 1975).

Using configuration-dependent projectors one constructs a generalized Lagrangian-Hamiltonian formalism for systems of many particles with holonomic constraints. The formalism is useful for treating problems in which the elimination of redundant co-ordinates is not convenient or the use of Lagrange multipliers is not suitable for the problem at hand. The method developed is a useful mathematical tool for treating collective processes in the many-body problem and can be the starting point for a quantization process for the many-body system restricted by holonomic constraints in configuration space. (auth)

31126 SCATTERING BY SINGULAR POTENTIALS WITH A PERTURBATION-THEORETICAL INTRODUCTION TO MATHIEU FUNCTIONS. Aly, H.H. (Department of Physics, Southern Illinois University at Edwardsville, Illinois); Müller-Kirsten, H.J.W.; Vahedi-Faridi, N. J. Math. Phys. (N.Y.) 16: No. 4, 961-970 (Apr 1975).

Different treatments of the important potential $1/r^4$ are correlated to understand their interrelations and to clear up the connection between the eigenvalues of Mathieu's equation and the poles of the S matrix. We also derive a new solution of the modified Mathieu equation. Mathematical and physical implications are also discussed. (auth)

31127 THEORY OF REGGE POLES FOR $1/r^2$ POTENTIALS. I. Mastalir, R.O. (Physics Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Math. Phys. (N.Y.) 16: No. 4, 743-748 (Apr 1975).

In the following series of papers we give a detailed study of the theory of Regge poles for $1/r^2$ potentials with the behavior $r^2 V(r) = -V_0$ at $r = 0$ and $r^2 V(r) = -V_2$ at $r = \infty$. We give a complete description of the distribution of the Regge poles in the λ plane, which is cut from $-V_0^{1/2}$ to $V_0^{1/2}$, and study the behavior of the pole trajectories. We find that the high-energy limit of the Regge poles is controlled by the parameter $p = (\lambda^2 - V_0)^{1/2}$ while at low energies the relevant parameter is $q = (\lambda^2 - V_2)^{1/2}$. This means that the point $\lambda = 0$ for the case of Yukawa potentials corresponds here to the point $q =$

0. We also find that the Regge trajectories $\lambda(E)$ may have branch points of the square root type at finite, in general complex, values of E at which points the pole passes the origin $\lambda = 0$. We further find that the kinematic singularity of the S matrix at $k = 0$ is more complicated than it is for Yukawa potentials and is here characterized by the Floquet parameter $\nu(\lambda,k)$ associated with the Schrödinger equation. We illustrate these and other results with some new exact solutions of the Schrödinger equation. (auth)

31128 THEORY OF REGGE POLES FOR $1/r^2$ POTENTIALS. II. AN EXACTLY SOLVABLE EXAMPLE AT ZERO ENERGY. Mastalir, R.O. (Physics Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Math. Phys. (N.Y.) 16: No. 4, 749-751 (Apr 1975).

We give the exact solution of the Schrödinger equation at zero energy and derive an expression in closed form for the Regge poles for a particular $1/r^2$ potential with the behavior $r^2V(r) = -V_0$ at $r = 0$ and $r^2V(r) = -V_2$ at $r = \infty$. We give detailed results on the properties and distribution of the Regge poles in the λ plane and find them to be in agreement with the predictions of a previous paper in this series. (auth)

31129 THEORY OF REGGE POLES FOR $1/r^2$ POTENTIALS. III. AN EXACT SOLUTION OF SCHRODINGER'S EQUATION FOR ARBITRARY l AND E. Mastalir, R. O. (Physics Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Math. Phys. (N.Y.) 16: No. 4, 752-755 (Apr 1975).

We give the exact solution of the radial Schrödinger equation and derive the S matrix for arbitrary energy and angular momentum for a particular $1/r^2$ potential with the behavior $r^2V(r) = -V_0$ at $r = 0$ and $r^2V(r) = -V_2$ at $r = \infty$. We obtain an expression for the Regge poles and study their properties and distribution at low energy. The present results are in agreement with those obtained in a previous paper in this series. (auth)

31130 ANGULAR MOMENTUM ANALYSIS OF A COMPOSITE PARTICLE SCATTERING PROBLEM AND ITS CROSS CHANNEL ANALOG. Jackson, S.A. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Ann. Phys. (N.Y.) 89: No. 1, 168-180 (Jan 1975).

We investigate the solutions, by a determinental method, for a partial-wave Bethe–Salpeter equation describing composite particle scattering and for its cross channel analog. We compare the behavior at $s = -\infty$ of the leading angular momentum singularity from the Bethe–Salpeter equation with that of the leading Regge singularity of the cross channel equation. We mention the effect of the general properties of the kernel of the Bethe–Salpeter equation on the angular momentum structure of the solution. (auth)

31131 A MULTIPERIPHERAL MODEL WITH CONTINUED CROSS CHANNEL UNITARITY. Jackson, S.A. (National Accelerator Laboratory, Batavia, Illinois 60510). Ann. Phys. (N.Y.) 89: No. 1, 149-167 (Jan 1975).

We derive, by using a spectral representation in momentum transfer, t, an integral equation, similar in structure to a multiperipheral equation, with continued cross channel unitarity, for the absorptive part for a composite particle scattering amplitude from a Bethe–Salpeter equation describing composite particle scattering in the s channel. At high energy in the t channel, the equation becomes homogeneous and has a Reggeized solution. We indicate how this equation may be solved using determinental techniques. We also show how the composite particle amplitude resulting from the original equation may be used to construct production and three-body amplitudes. We also infer the possibility of studying, using the amplitude from the cross channel problem, the effect of extra unitarity on Reggeon–Reggeon–particle vertices. (auth)

31132 INTEGRAL EQUATIONS FOR THE SCATTERING OF N IDENTICAL PARTICLES. Bencze, Gy. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)); Redish, E. F. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique Theorique). Nucl. Phys., A; 238: No. 2, 240-252(3 Feb 1975).

Integral equations are obtained for the scattering of N identical particles using a form of the N-particle scattering equations derived previously. The equations couple together only transition operators between physical two cluster channels, the breakup amplitudes being expressed in terms of quadratures over two-cluster amplitudes. The kernel of the equations becomes connected after a single iteration. The number of coupled equations for identical particles is $\frac{1}{2}N$ or $\frac{1}{2}(N-1)$ when N is even or odd respectively. (auth)

31133 A MODEL FOR CROSSING MULTIPARTICLE AMPLITUDES BASED ON THE SUBSTITUTION RULE. Klink, W. H. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Phys., B; 86: No. 1, 182-188(3 Feb 1975).

Relations between multiparticle amplitudes describing crossed reactions are given in an algebraic (group theoretical) framework using the substitution rule, rather than the traditional analytic (S-matrix) framework. (auth)

31134 EXPERIMENTAL FAILURE OF SHORTEST-PATH TECHNIQUE IN INELASTIC PARTIAL WAVE ANALYSIS. Dean, N. W.; Jensen, T. C.; Long, W. F. (Ames Lab., Iowa (USA)). Phys. Lett., B; 53: No. 5, 462-466(6 Jan 1975).

A feasibility test has been conducted of the usual partial wave analysis procedure by generating ersatz experimental data for an inelastic reaction from a known set of partial waves, then attempting to subject them to partial-wave analysis. The presence of the ambiguous solutions proposed by Dean and Lee at all energies prevents the usual procedure from succeeding; the shortest path solutions are not the correct ones. (auth)

31135 CANONICAL VARIABLES FOR CROSSING MULTIPARTICLE AMPLITUDES. Klink, W. H. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Phys., B; 86: No. 1, 175-181 (3 Feb 1975).

Canonical variables for arbitrary multiparticle amplitudes are defined which have the property that under crossing all variables except two energies stay in their physical domain. (auth)

31136 EFFECTIVE HAMILTONIAN METHOD FOR THE SOLUTION OF THE SCHROEDINGER EQUATION. I. The One-Dimensional Problem. Hennell, M. A. (Univ. of Liverpool). J. Phys., A (London); 8: No. 2, 171-178(Feb 1975).

A method is presented for solving the one-dimensional Schroedinger equation in which the potential is approximated by a step function. This effective Hamiltonian is then solved exactly by a continued fraction technique which enables the convergence properties to be studied. The method is particularly suitable for the solution of scattering problems for which upper and lower bounds can be obtained for the phase shifts. (auth)

31137 NONLINEAR EQUATIONS AMENABLE TO THE INVERSE SCATTERING METHOD. Kingston, J. G. (Univ. of Nottingham, Eng.); Rogers, C. Can. J. Phys.; 53: No. 1, 58-61 (1 Jan 1975).

The inverse scattering method can be used to solve the initial value problem for various nonlinear evolution equations of physical importance. An extensive class of equations for which the technique is available is delimited. (auth)

31138 BREAKING OF DYNAMICAL SYMMETRIES AND SCATTERING PHASE SHIFT. Andreev, V. A. Teor. Mat. Fiz.; 22: No. 2, 223-230(Feb 1975). (In Russian).

The notion of the broken dynamical symmetry is introduced with the aid of constructing operators which generalize the Runge–Lentz vector for the hydrogen atom. The connection between commutators of these operators with the Hamiltonian and phase shifts is established. The cases when the symmetry is defined on a discrete and continuous spectrum are considered separately. (auth)

31139 RELATIVISTIC AMPLITUDES OF ONE-BOSON EXCHANGE AS QUANTUM-MECHANICAL POTENTIALS IN LOBACHEVSKII SPACE. Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 22: No. 2, 213-222(Feb 1975). (In Russian).

It is shown that the matrix elements of the relativistic scattering amplitude which correspond to one-boson exchange can be represented in the form of the direct geometrical generalization of quantum-mechanical potentials, obtained by means of replacement of euclidean quantities by their analogs in Lobachevsky space. (auth)

31140 SUM RULES FOR THE PHASE SHIFT. Puff, R. D. (Univ. of Washington, Seattle). Phys. Rev., A; 11: No. 1, 154-159 (Jan 1975).

It is observed that a number of phase-shift rules can be deduced from properties of the Jost function. The simplest of these is $\int_0^\infty (d\epsilon/\pi)[\delta_l(\epsilon) - \delta_l^B(\epsilon)] = \Sigma_n \epsilon_{nl}$ where $\delta_l(\epsilon)$ is the phase shift, $\delta_l^B(\epsilon)$ is the first Born approximation to the phase shift, and ϵ_{nl} is the nth bound-state energy with angular momentum l. (auth)

PHYSICS (LOW-TEMPERATURE)

Refer also to abstracts 30330, 30331, and 30333.

Superfluidity

31141 (COO-1569-121) ANALYSIS OF $^3He-^4He$ MIXTURE SPECIFIC HEAT DATA. Dockendorf, L. (Minnesota Univ., Minneapolis (USA)). Dec 1974. Contract AT(11-1)-1569. 78p. Dep. NTIS $7.00.

Thesis.

Specific-heat data for helium-3–helium-4 mixtures in the vicinity of the tricritical point were taken previously and partially analyzed. This data set was analyzed further here, in an effort to understand better the nature of the phase transitions, as well as to look at the other thermodynamic properties of the system, especially those that have been investigated by some other method. Specific-heat functional forms were discovered which adequately describe the data. Additional parameters were also tabulated for forms corresponding to the first derivatives of Δ, which are somewhat consistent with the forms of the specific heat. Finally, a scaling form has been checked in the gross region of the tricritical point, with no success of confirmation of that form. (MHR)

31142 LOW TEMPERATURE PHYSICS: LT 13. Volume 1. Quantum Fluids. 13th International Conference Held at Boulder, Colorado, August 21–25, 1972. Timmerhaus, K. D.; O'Sullivan, W. J.; Hammel, E. F. (eds.). New York; Plenum Publishing Corporation (1974). 684p. (CONF-720833-(P1)). $35.00.

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972).

One hundred twenty-nine papers were included. Separate abstracts were prepared for each. (MHR)

For abstracts of individual papers see: 31143–31271.

31143 LIGHT SCATTERING AS A PROBE OF LIQUID HELIUM Greytak, T. J. (Massachusetts Inst. of Tech., Cambridge). pp 9-18 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Laser light sources and advances in optical spectrometers have made possible the use of inelastic light scattering as a probe of liquid helium. Pure ^4He, pure ^3He, and isotopic mixtures have been studied in several laboratories. The experiments fall into two categories: Brillouin and Raman scattering. The work in these areas is reviewed briefly and it is concluded that light scattering provides valuable new information about the properties of liquid and solid helium, and that the results obtained complement rather than supplant the results of neutron and x-ray scattering. (MHR)

31144 PHASE DIAGRAM OF HELIUM MONOLAYERS. Dash, J. G. (Univ. of Washington, Seattle). pp 19-25 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

In the limit of a single monolayer the substrate properties can become extremely important; and one must be at least as concerned with the characteristics of the substrate and the surface-helium interactions as with the helium–helium interactions. Arguments for this view are given. Information concerning the properties of helium on graphite is presented. Some independent evidence concerning the uniformity of graphite is examined. (MHR)

31145 HELIUM-3 IN SUPERFLUID HELIUM-4. Edwards, D. O. (Ohio State Univ., Columbus). pp 26-35 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Some topics of interest are reviewed, among them: studies of the surface of liquid helium, the quasiparticle theory, the hydrodynamic model, and the Andreev model. (MHR)

31146 SOME RECENT DEVELOPMENTS CONCERNING THE MACROSCOPIC QUANTUM NATURE OF SUPERFLUID HELIUM. Putterman, S. (Univ. of California, Los Angeles). pp 39-45 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Those aspects of the macroscopic behavior of He II are discussed that are most closely related to the quantum theory. Among the topics discussed are: the Landau two-fluid hydrodynamics, the ideas of Onsager and Feynman, the restriction of irrotational superfluid flow, the quantization of circulation, and third-sound absorption. (MHR)

31147 NEUTRON SCATTERING INVESTIGATION OF BOSE–EINSTEIN CONDENSATION IN SUPERFLUID ^4He. Mook, H. A.; Scherm, R.; Wilkinson, M. K. (Oak Ridge National Lab., TN). pp 46-49 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. E. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The measurements were made on a triple-axis spectrometer at a constant scattering angle of 135 and a momentum transfer of 14.33 A^{-1}. The results of the measurements are shown for ^4He at 1.2 and 4.2 K. The data have all been normalized to one run which represents about 20 min counting time per point. Of course, many runs were performed, especially in the area near the peak top where evidence for a condensate is expected. An estimate of the condensate fraction is given as 2.4 1%. (MHR)

31148 TEMPERATURE AND MOMENTUM DEPENDENCE OF PHONON ENERGIES IN SUPERFLUID ^4He. Havlin, S.; Luban, M. (Bar-Ilan Univ., Ramat-Gan, Israel). pp 50-53 of Low Temperature Physics: LT 13. Vol 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The results are reported here of a calculation of the excitation spectrum of superfluid ^4He based on the Landau quantum hydrodynamics model. An analytic expression is obtained for the sound velocity, which is in excellent agreement with experiment as a function of both temperature and angular frequency. The result for δ is of the same order of magnitude, although smaller by a factor of 2.5 than the experimental value. (MHR)

31149 DOES THE PHONON SPECTRUM IN SUPERFLUID ^4He CURVE UPWARD. Eckstein, S. G.; Friedlander, D.; Kuper, C. G. (Israel Inst. of Tech., Haifa). pp 54-56 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The theory of canonical transformations is used to demonstrate that the phonon spectrum must be concave at low momenta. It is shown that if the spectrum were convex, there could be no three-phonon vertex in the interaction; a fortiori, there can be no three-phonon process in the attenuation of sound. However, the experimental dependence of the attenuation on frequency and temperature is clearly that of a three-phonon process. Hence the spectrum must be concave. (MHR)

31150 MODEL DISPERSION CURVES FOR LIQUID ^4He. Brooks, J. S.; Donnelly, R. J. (Univ. of Oregon, Eugene). pp 57-60 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

A method was developed which gives a continuous representation of the excitation spectrum (energy vs. momentum) for superfluid helium as a function of temperature and density, using neutron scattering data to determine the behavior of the various parameters which describe the shape of the spectrum. This model spectrum was applied to the calculation of various thermodynamic properties of the liquid. (MHR)

31151 ANALYSIS OF DYNAMIC FORM FACTOR $S(k,\omega)$ FOR THE TWO-BRANCH EXCITATION SPECTRUM OF LIQUID ^4He. Soda, T.; Sawada, K.; Nagata, T. (Tokyo Univ. of Education). pp 61-66 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The intensity curves of the dynamic form factor obtained by the neutron scattering experiments of Cowley and Woods are explained in terms of the energies of one- and two-phonon excitations and their decay rate for small momenta. (MHR)

31152 EXCITATION SPECTRUM FOR WEAKLY INTERACTING BOSE GAS AND THE LIQUID STRUCTURE FUNCTION OF HELIUM. Bhattacharyya, A.; Woo, C. W. (Northwestern Univ., Evanston, IL). pp 67-71 of Low Temperature Physics:

LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The excitation spectrum of a Bose gas characterized by a pairwise Fourier transformable potential is calculated to three leading orders in the strength parameter, first by the Hugenholtz-Pines prescription, then by the method of correlated basis functions. (MHR)

31153 ELEMENTARY EXCITATIONS IN LIQUID HELIUM. Woo, C. W. (Northwestern Univ., Evanston, IL). pp 72-75 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

An attempt to develop a theory which accounts for the two branches of excitations on equal footing, at least in the limit of long wavelengths is discussed here. It is a microscopic theory based on a generalization of Feynman's treatment of the phonon-roton spectrum. (MHR)

31154 LONG-WAVELENGTH EXCITATIONS IN A BOSE GAS AND LIQUID He II AT T = 0. Gould, H. (Clark Univ., Worcester, MA); Wong, V. K. pp 76-79 of Low Temperature Physics: LT 13. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Various assumptions have been made about the nature of the long-wavelength excitations of liquid He II. A theoretical justification of the various assumptions is needed. However, one test of these assumptions is by rigorous microscopic analysis of a solvable model of a Bose gas. Another is by a qualitative analysis coupled with the use of plausible sum rule arguments. First, a simple qualitative analysis of the structure of the dynamic structure function, $S(k,\omega)$ is considered. A simple multiphonon diagram for the density–density response function is considered. It is concluded that the one-phonon Feynman relation for structure functions breaks down at order k^3. The calculation extended to all orders in perturbation theory by using a Ward identity to determine the vertices. It is concluded that the excitation spectrum $\omega(k)$ is a nonanalytic function of k due to the logarithmic singularity associated with the long-wavelength limit of a propagator pair. These qualitative arguments are confirmed by a rigorous microscopic analysis of a dilute Bose gas at T = 0. The microscopic calculations of $S(k,\omega)$, $S(k)$, and $\omega(k)$ were made using a dielectric formulation cast into a convenient form by use of Ward-type identities based on the continuity equation. (MHR)

31155 BOSE–EINSTEIN CONDENSATION IN TWO-DIMENSIONAL SYSTEMS. Imry, Y. (Tel Aviv Univ., Israel); Bergman, D. J.; Gunther, L. pp 80-83 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

It is an accepted fact that two- and one-dimensional systems of bosons do not undergo Bose–Einstein condensation at any finite temperature. It is pointed out that while this is true when the system is kept at a fixed volume, a quite different behavior is obtained if the system is kept instead at a fixed pressure. In the latter case an ideal Bose gas undergoes a continuous phase transition (i.e., not a first-order transition) to a state where all the particles are condensed in the lowest-lying single particle state. A modified form of this transition may remain even in realistic systems of interacting bosons. How this transition arises in two dimensions is shown. (MHR)

31156 PHONONS AND LAMBDA TEMPERATURE IN LIQUID ^{4}He AS OBTAINED BY THE LATTICE MODEL. Meijer, P. H. E. (Catholic Univ. of America, Washington, DC); Scherer, W. D. pp 84-86 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

A face-centered lattice is considered and a set of operators a_i^* and a_i defined which create and annihilate Bose particles at the site of the lattice. A prolate form is also considered. Two equations relating the density, the temperature, and the chemical potential were obtained: one for above the lambda temperature and one for below the lambda temperature. (MHR)

31157 EQUATION OF STATE FOR HARD-CORE QUANTUM LATTICE SYSTEM. Horiguchi, T.; Tanaka, T. (Ohio Univ., Athens). pp 87-91 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. E. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

An attempt is made to explain the fact that the melting curves for ^{3}He and ^{4}He have a negative slope for awhile until a minimum melting temperature is reached and increase at higher temperatures. The order-disorder theory is applied to the Matsubara and Matsuda quantum lattice model and it is shown that in the lower-temperature region the melting curve has a negative slope within the pair approximation of the cluster variation method. (MHR)

31158 IMPULSE OF A VORTEX SYSTEM IN A BOUNDED FLUID. Huggins, E. R. (Dartmouth Coll., Hanover, NH). pp 92-95 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The dynamic equation for the fluid impulse of a vortex system in a bounded charged or uncharged fluid is derived from the equation of motion of a classical constant-density fluid. The result is an integral theorem which primarily describes the effect of nonpotential forces upon the vorticity field $\omega = \nabla \times v$. Although the equations treat ω as a continuous field, the main application of the impulse theorem has been to quantum fluids where a vortex core is usually considered to be a δ-function singularity in the field $\nabla \times v$. It is shown how the concept of a continuous vorticity field can be applied to a quantum fluid, if ω is redefined as the curb of the physical current $j = \rho v$. (MHR)

31159 NEW RESULTS ON THE STATES OF THE VORTEX LATTICE. Le Ray, M.; Deroyon, J. P.; Deroyon, M. J.; Francois, M.; Vidal, F. (Centre Univ., Valenciennes, France). pp 96-100 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

It was found previously that in the presence of a counterflow or a superflow normal to the axis of rotation, the vortex lattice created by the rotation is modified. The modifications are studied with second-sound attenuation measurements and some of the latest results are reported. In particular, systematic measurements were performed at various temperatures and with various angles between the flow and the axis of rotation, using second-sound normal to the flow and either normal to the axis of rotation or parallel to the axis. (MHR)

31160 SUPERFLUID DENSITY IN PAIRING THEORY OF SUPERFLUIDITY. Evans, W. A. B.; Rashid, R. I. M. A. (Univ. of Kent, Canterbury, Eng.). pp 101-107 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. E. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Previously, the need to insure that qualitatively important conservation laws (e.g., number conservation, f-sum rule, momentum and energy conservation laws, etc.) still be satisfied in any useful approximation has been emphasized. Here, what amounts to an equivalent technique is applied to the superfluid density problem within the pair theory of the Bose superfluid as presented by Evans and Imry. The details of this method differ slightly in that temperature Green's functions are employed. The approximate two-body propagator is obtained by the functional differentiation of the approximate single-body propagator of the pair model. Since the exact propagators obey the same relation (via functional differentiation), it is evident that the resulting approximation will satisfy all conservation laws that are expressible in terms of the single-body propagator and its functional derivative. (MHR)

31161 ^{3}He–ROTON INTERACTION. Tan, H. T. (Univ. of Malaya, Kuala Lumpur, Malaysia); Tan, M.; Woo, C. W. pp 108-111 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

For lack of more detailed knowledge concerning the interactions between elementary excitations in liquid helium, Khalatnikov's theory of transport phenomena has described such interactions in terms of δ-function potentials. Recent measurements of the diffusion constant of very dilute ^{3}He–^{4}He solutions at temperatures slightly above 1°K call into question the validity of such simple models. It is indicated that the temperature variation of the kinetic coefficients may depend sensitively upon the form of the ^{3}He–roton scattering cross section. Here, as a first step toward obtaining the diffusion coefficient D(T), a microscopic calculation of the effective ^{3}He–roton cross section is presented. (MHR)

31162 QUANTUM LATTICE GAS MODEL OF ^{3}He–^{4}He MIXTURES. Cheng, Y. C.; Schick, M. (Univ. of Washington, Seattle). pp 112-115 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The extension of the quantum lattice gas model of Matsubara and Matsuda is considered in order to apply it to ^{3}He–^{4}He mixtures. After defining the model, its phase diagram is obtained within mean-field theory. (MHR)

31163 S = 1 ISING MODEL FOR ^{3}He–^{4}He MIXTURES. Ng, W. M.; Barry, J. H.; Tanaka, T. (Ohio Univ., Athens). pp 116-120 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

As a preliminary study toward understanding phase transitions in ^{3}He–^{4}He mixtures, the S = 1 Ising model has recently been proposed. Within the Weiss molecular-field approximation, qualitatively good agreement was obtained in comparison with experiment. To improve beyond the Weiss approximation, this model is examined in a spin-pair approximation using the cluster-variation method and working in a canonical ensemble. (MHR)

31164 LOW TEMPERATURE THERMODYNAMICS OF FERMI FLUIDS. Ford, A.; Mohling, F.; Rainwater, J. C. (Univ. of Colorado, Boulder). pp 121-129 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

It is shown how the temperature coefficients in the low temperature expansions of thermodynamic quantities for a normal Fermi fluid can be determined from Landau's phenomenological theory. Using the dilute hard-sphere Fermi gas as a model, for which explicit results can be calculated from microscopic theory, parameterized expansions about the Fermi surface of the basic Landau energy functions are proposed. (MHR)

31165 DENSITY AND PHASE VARIABLES IN THE THEORY OF INTERACTING BOSE SYSTEMS. Berdahl, P. (Stanford Univ., CA). pp 130-134 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

A unified presentation of the introduction of canonical density and phase variables for Bose systems is given, within the context of field theory. (MHR)

31166 SUBCORE VORTEX RINGS IN A GINSBURG–LANDAU FLUID. Huggins, E. R. (Dartmouth Coll., Hanover, NH). pp 135-139 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The hydrodynamic limit of the Schroedinger equation, Maxwell's equations applied to a laser beam, and the Abrahams–Tsuneto T = 0 time-dependent Ginzburg–Landau (GL) theory of superconductivity are discussed. The main aim is to illustrate the close relationship between the three theories and to discuss some features of the vortex solutions. Of particular interest are the subcore vortex rings in the time-dependent GL theory. (MHR)

31167 MULTILAYER HELIUM FILMS ON GRAPHITE. Bretz, M. (Univ. of Washington, Seattle). pp 143-146 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Recent experiments on monolayer helium films absorbed on an exfoliated graphite substrate demonstrate the crucial importance of substrate homogeneity and cleanliness for monolayer film properties. Since all multilayer helium film experiments were performed on presumably heterogeneous substrates, an attempt is made to test whether a graphite substrate would influence multilayer film behavior to any appreciable extent. (MHR)

31168 SUBMONOLAYER ISOTOPIC MIXTURES OF HELIUM ADSORBED ON GRAFOIL. Hering, S. V.; Hickernell, D. C.; McLean, E. O.; Vilches, O. E. (Univ. of Washington, Seattle). pp 147-151 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Monolayers or submonolayers of helium adsorbed on different substrates have been studied for several years. Heat capacity signatures for He on rouge, Vycor, and bare and rare-gas-plated copper resemble those of two-dimensional (2D) Debye systems. Only recently measurements done on a commercially available variety of graphite, Grafoil, have given results that can be compared to 2D quantum and classical gases. The present specific heat measurements were made on submonolayer isotopic mixture films adsorbed on Grafoil. Specific heat results for one of the mixtures are shown. Entropies at 4 K were calculated and plotted. (MHR)

31169 SPATIAL ORDERING TRANSITIONS IN QUANTUM LATTICE GASES. Siddon, R. L.; Schick, M. (Univ. of Washington, Seattle). pp 152-155 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The effects of statistics and quantum mechanical tunneling on the spatial ordering transitions of adsorbed gases are investigated. To do so, a system of atoms adsorbed on a substrate which is divided into M cells of area d^2 corresponding to adsorption sites is considered. Restricting the atoms to these cells results in a quantum lattice gas. It is found that the maximum temperature of transitions to the ordered phase depends, in decreasing order of importance, on the interaction strength, the particle mass, and the statistics. (MHR)

31170 MODEL OF THE ^{4}He MONOLAYER ON GRAPHITE. Nakajima, S. (Univ. of Illinois, Urbana). pp 156-158 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Experiments show that the He monolayer adsorbed on graphite is a new, 2D quantum system. The simplest model is the tight binding approximation, in which the zeroth-order wave function of the adsorbed atom is localized around the center of the hexagonal unit cell of graphite. It is concluded here that the model of Matsubara and Matsuda is much more appropriate and realistic for the ^{4}He monolayer. Qualitative features of the model are shown by applying the molecular field approximation. (MHR)

31171 THERMAL PROPERTIES OF THE SECOND LAYER OF ADSORBED ^{3}He. Thomson, A. L.; Brewer, D. F.; Stanford, J. (Univ. of Sussex, Brighton, Eng.). pp 159-162 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements were made of the specific heats of ^{3}He films with thicknesses between one and two atomic layers. The adsorbent was Vycor porous glass on which previous experiments have shown that the first adsorbed layer possesses a specific heat proportional to T^2, which is indicative of a two-dimensional solid. The measurements presented here were obtained with five different fractions of the second layer ranging from one-fourth up to the completed layer; the results are shown. (MHR)

31172 NUCLEAR MAGNETIC RESONANCE INVESTIGATION OF ^{3}He SURFACE STATES IN ADSORBED ^{3}He–^{4}He FILMS. Brewer, D. F.; Creswell, D. J.; Thomson, A. L. (Univ. of Sussex, Brighton, Eng.). pp 163-166 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Nuclear susceptibility measurements of ^{3}He atoms adsorbed on the free surface of a ^{4}He film were made. An isotopic mixture was adsorbed in porous Vycor glass. Continuous-wave NMR techniques were employed, the susceptibility being obtained by electronically integrating the area under the absorption line using phase-sensitive detection. A conventional ^{3}He cryostat enabled temperatures within the range 0.3 to 1.5 K to be conveniently maintained. Within the scatter, all the data superimpose remarkably onto a unique curve resembling the degeneracy curve of a Fermi gas or of liquid ^{3}He. An interpretation of the data is given. (MHR)

31173 NUCLEAR MAGNETIC RELAXATION OF LIQUID ^{3}He IN A CONSTRAINED GEOMETRY. Kelly, J. F.; Richardson, R. C. (Cornell Univ., Ithaca, NY). pp 167-171 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The nuclear magnetic relaxation properties of liquid ^{3}He con-

tained within a vessel filled with fine carbon powder were measured. The apparatus for the experiment consisted of a pulsed NMR spectrometer and a $^3He-^4He$ dilution refrigerator. The results of the T_1 measurements using liquid ^3He with an isotopic impurity concentration of 0.2% ^4He and at a pressure of 0.3 atm are shown. (MHR)

31174 LOW-TEMPERATURE SPECIFIC HEAT OF ^4He FILMS IN RESTRICTED GEOMETRIES. Tait, R. H.; Pohl, R. O.; Reppy, J. D. (Cornell Univ., Ithaca, NY). pp 172-176 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Padmore proposed a model for long-wavelength phonons in a "zero-dimensional geometry" that gave a linear temperature dependence and a constant heat capacity at low temperatures. This heat capacity work was carried out both to evaluate the validity of Padmore's model and to extend to lower temperatures (0.06 to 0.6°K) the ^4He film studies. (MHR)

31175 MEAN FREE PATH EFFECTS IN ^3He QUASIPARTICLES: MEASUREMENT OF THE SPIN DIFFUSION COEFFICIENT IN THE COLLISIONLESS REGIME BY A PULSED GRADIENT NMR TECHNIQUE. Brewer, D. F.; Rolt, J. S. (Univ. of Sussex, Brighton, Eng.). pp 177-181 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The low-temperature properties of bulk liquid ^3He are broadly consistent with Landau quasiparticle theory although they do not, in a precise sense, verify its correctness. The results are reported of the direct observation of mean free path effects in the quasiparticles. The measurements are of the spin diffusion coefficient of ^3He confined to narrow channels at temperatures low enough for the quasiparticles to be in the collisionless regime. The results are in agreement with modified Landau theory which does not involve the usual temperature-dependent mean free path. (MHR)

31176 ADSORPTION OF ^4He ON BARE AND ON ARGON-COATED EXFOLIATED GRAPHITE AT LOW TEMPERATURES. Lerner, E.; Daunt, J. G. (Stevens Inst. of Tech., Hoboken, NJ). pp 182-184 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements were made of adsorption isotherms of ^4He on bare, exfoliated graphite (Grafoil) and on the same substrate coated with a completed monolayer of argon. The isotherms were measured at 4.2, 6.18, 7.90, 9.65, 11.60, 13.50, 15.08, and 18.55°K in the pressure range 0.25 to 25 Torr using an apparatus which has been described previously. Thermomolecular pressure corrections were less than 3% even at the lowest temperatures and the accuracy of pressure measurement was within 0.5%. A typical family of isotherms for ^4He on the Grafoil coated with a monolayer of argon is given. The general shape of this family of isotherms, particularly those at 7.90, 6.18, and 4.2°K, suggests that at pressures below about 0.5 Torr the system becomes a two-phase system with a critical temperature between 6.18 and 7.9°K. From these data and from the isotherms on the bare Grafoil, the isosteric heats of adsorption were computed as a function of the coverage. The results of this computation are shown. (MHR)

31177 ELLIPSOMETRIC MEASUREMENTS OF THE SATURATED HELIUM FILM. Matheson, C. C.; Horn, J. L. (Univ. of East Anglia, Norwich, Eng.). pp 185-189 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

A fully automatic ellipsometer has been developed which will track continuously and rapidly changes in both the phase change and the relative amplitude change produced by reflection. Thus formation and destruction of the helium film may be readily observed. Some preliminary measurements of the film obtained with this instrument are reported and means of analyzing the data are discussed. (MHR)

31178 MOMENTUM AND ENERGY TRANSFER BETWEEN HELIUM VAPOR AND THE FILM. Blair, D. G.; Matheson, C. C. (Univ. of East Anglia, Norwich, Eng.). pp 190-194 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The torsional oscillator helium film detector gives a number of anomalous results. It is shown here that these results are explained if the momentum transfer ratio between helium vapor and the film depends on the film thickness. To obtain further information about the film–vapor interaction, the behavior of the helium film on the levitated substrate was examined using an automatic ellipsometer. (MHR)

31179 NUCLEAR MAGNETIC RESONANCE STUDY OF THE FORMATION AND STRUCTURE OF AN ADSORBED ^3He MONOLAYER. Creswell, D. J.; Brewer, D. F.; Thomson, A. L. (Univ. of Sussex, Brighton, Eng.). pp 195-199 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements are presented on the spin–lattice and spin–spin relaxation times for ^3He atoms adsorbed on Vycor glass; from these results it is possible to estimate both the correlation time, which is related to mobility, and the second moment of the nuclear magnetic resonance line, which depends on the spatial arrangement of the atoms. It is found that the configuration of the atoms is strongly dependent on the fractional coverage θ, in particular indicating a solid arrangement for values of $\theta \gtrsim \frac{1}{2}$. (MHR)

31180 PULSED NUCLEAR RESONANCE INVESTIGATION OF THE SUSCEPTIBILITY AND MAGNETIC INTERACTION IN DEGENERATE ^3He FILMS. Brewer, D. F.; Rolt, J. S. (Univ. of Sussex, Brighton, Eng.). pp 200-205 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Continuous-wave nuclear resonance measurements have been made recently of the susceptibility and spin–lattice relaxation times on films of pure ^3He and $^3He-^4He$ mixtures in the temperature range between 1.5 and 0.4°K for various film thicknesses. In the region investigated the films either were classical, in the sense that their susceptibility followed a Curie law, or showed only small (up to ~26%) Fermi degeneracy, depending on coverage and temperature. It was shown that the susceptibility was consistent with a statistical layer model in which the first two layers could be considered as magnetically independent of each other and of the rest of the film, and each layer region of the film exhibited the same susceptibility as that of bulk ^3He at the same interatomic spacing. Here, it is shown that there are large deviations from this model at lower temperatures down to 50 m°K, in such a direction as to indicate a lower Fermi temperature in the real film than in the model, or a larger ferromagnetically inclined exchange interaction. (MHR)

31181 MEASUREMENTS AND CALCULATIONS OF THE HELIUM FILM THICKNESS ON ALKALINE EARTH FLUORIDE CRYSTALS. Sabisky, E. S.; Anderson, C. H. (RCA Labs., Princeton, NJ). pp 206-210 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Accurate measurements were made of the thickness of helium films adsorbed on alkaline earth fluoride crystals as a function of the van der Waals potential. Accurate and reliable measurements of the film thickness on cleaved surfaces of SrF_2 crystals at 1.38°K are presented. The films were measured between 10 and 250 Å using an acoustic interferometry technique. The exceptionally good agreement found between the film thickness measurements and those calculated using the Lifshitz formula leaves very little uncertainty about the thickness on these crystals. It must also be concluded that for dielectric substrates and clean metal surfaces the film thickness, when greater than the surface roughness, is given by the Lifshitz formula about as accurately as can be obtained from present measurements. (MHR)

31182 NORMAL FLUID FRACTION IN THE ADSORBED HELIUM FILM. Yang, L. C. (Univ. of California, Los Angeles); Chester, M.; Stephens, J. B. pp 211-215 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The resonant frequency of a thickness-shear mode oscillating quartz crystal is lowered by virtue of the mass loading of any film laid down on its surfaces. The mass adsorbed was measured as a function of the helium gas pressure in the experimental chamber up to the saturation vapor pressure for a series of temperatures. Several representative isotherms obtained by employing a 24-MHz, 39 49′, Y-cut quartz crystal are shown. (MHR)

31183 HELIUM II FILM TRANSFER RATES INTO AND OUT OF SOLID ARGON BEAKERS. Milbrodt, T. O.; Pollack, G. L. (Michigan State Univ., East Lansing). pp 219-223 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

He II film flow was studied over a surface whose interaction with the He is well understood. Solid Ar beakers were made and emptying and filling of the beakers by superfluid film transfer was studied. The dependence of the transfer rate on level difference, film height, and temperature was studied. It was found that the observed film height dependence and observed dependence on driving force were generally in good agreement with theory. The flow rates were 20 to 30% lower than expected from theory. The results of beaker emptyings and fillings usually agree with each other to 10%. (MHR)

31184 PREFERRED FLOW RATES IN THE HELIUM II FILM. Harris-Lowe, R. F.; Turkington, R. R. (Royal Military Coll., Kingston, Ont.). pp 224-228 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The most recent results in an extended series of experiments designed to investigate the reproducibility of helium film flow rates out of a Pyrex beaker at a temperature of 1.35 K are reported. The basic technique involved the use of a coaxial capacitance depth gauge, and associated bridge circuit to monitor changes in the helium level in the beaker. The method allowed an accurate determination of the flow rate every 10 sec. A fountain pump was used to change the level in the beaker by controlled amounts. The method resulted in an improvement in the resolution by a factor of about 40 over any previous measurements. (MHR)

31185 SUPERFLUIDITY OF THIN HELIUM FILMS. Chan, H. W.; Yanof, A. W.; Pobell, F. D. M.; Reppy, J. D. (Cornell Univ., Ithaca, NY). pp 229-232 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The question of superfluidity in the thinnest possible films, one or two atomic layers adsorbed on a solid substrate, is examined. The existence of stable, nondissipative flow states is taken as the criterion for superfluidity. The cryostat is equipped with a recirculating ^{3}He refrigerator so that persistent currents can be created and observed at temperatures as low as 0.5 K. A substrate of porous Vycor glass is used to provide a large surface area for the film. The angular momentum measured at 0.5 K prior to decay is plotted as a function of helium coverage. The angular momentum is shown as a function of temperature for four different coverages. Onset temperature as a function of ^{4}He coverage is shown for both the bare Vycor and the neon-preplated substrate. (MHR)

31186 SUPERFLUIDITY IN THIN ^{3}He–^{4}He FILMS. Ratnam, B.; Mochel, J. (Univ. of Illinois, Urbana). pp 233-238 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Third-sound resonance experiments have shown that the superfluid helium film can be studied with remarkable precision. It was shown that small quantities of ^{3}He in an adsorbed superfluid ^{4}He film leave the critical onset temperature unchanged but profoundly affect the third-sound velocity and attenuation. (MHR)

31187 ABSENCE OF MODERATE-VELOCITY PERSISTENT CURRENTS IN He II FILMS ADSORBED ON LARGE CYLINDERS. Wang, T.; Rudnick, I. (Univ. of California, Los Angeles). pp 239-242 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Experiments are described where the rotations are initiated while $T < T_\lambda$. Rotations were also initiated at $T > T_\lambda$ with the rotation continuing as T is reduced below T_λ. No relative velocity was observed when the rotation was then gradually reduced to zero. It is tentatively concluded that persistent currents of velocity greater than about 1 cm sec^{-1} on cylinders greater than about 1 cm are not observable. (MHR)

31188 THERMODYNAMICS OF SUPERFLOW IN THE HELIUM FILM. Goodstein, D. L.; Staffman, P. G. (California Inst. of Tech., Pasadena). pp 243-246 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

In order to investigate the boundary conditions at the interface, the conditions for thermodynamic equilibrium between a film obeying the two-fluid model and its vapor were examined. The analysis may be tested by means of a prediction it makes for the speed of third sound in a moving film. (MHR)

31189 MASS TRANSPORT OF ^{4}He FILMS ADSORBED ON GRAPHITE. Herb, J. A.; Dash, J. G. (Univ. of Washington, Seattle). pp 247-250 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

A complex of onset phenomena are reported here which have not been seen in films on typical substrates. Mass transport of ^{4}He multilayers on Grafoil along directions parallel to the basal plane graphite surfaces was studied. The experimental cell consists of two chambers connected through a Grafoil gasket, permitting surface transport along the basal plane direction. Sample results of over 20 coverages are shown. (MHR)

31190 HELIUM FILM FLOW DISSIPATION WITH A RESTRICTIVE GEOMETRY. Liebenberg, D. H. (Los Alamos Scientific Lab., NM). pp 251-252 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements of the dissipation in the thermally driven superfluid helium film are continuing. Previous results have been obtained using a glass post of either constant or stepped cross section to determine the applicability of the fluctuation-dissipation model to the development of dissipation in film flow. It was judged useful to determine what effect the limitation of dissipation along the flow path would have on the character and growth of dissipation. The observed growth of dissipation was similar to that observed for the constant-diameter posts. At low superfluid velocities along the post the dissipation is characterized by the fluctuation-dissipation model. The onset of saturation is observed at larger flow velocities. As saturation is approached an instability is observed in the measured dissipation. It is suggested that the instability is related to the boundary conditions imposed on the dissipation that increases the dissipation gradient in this flow process. (MHR)

31191 DISSIPATION IN THE FLOWING SATURATED SUPERFLUID FILM. Hoffer, J. K.; Fraser, J. C.; Hammel, E. F.; Campbell, L. J.; Keller, W. E.; Sherman, R. H. (Los Alamos Scientific Lab., NM). pp 253-257 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The flow of the saturated helium II film through an inverted U-tube connecting two reservoirs of bulk liquid was measured with improved precision to provide a direct experimental determination of the intrinsic dissipation in the film as a function of velocity and temperature. (MHR)

31192 DISSIPATION IN SUPERFLUID HELIUM FILM FLOW. Allen, J. F.; Armitage, J. G. M.; Saunders, B. L. (Univ. of St. Andrews, Scotland). pp 258-262 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The dissipation processes which accompany superfluid flow in saturated helium films were studied as a function of flow rate, temperature, and film height on thickness. The film flow into or out of a glass beaker was driven at a chosen rate by expanding or compressing bellows which were attached to the bottom of the beaker. The bellows were driven remotely via a hydraulic link to minimize vibration. The cryostat was essentially vibration-free, including elimination of boiling nitrogen from contact with the helium dewar. Two regimes of dissipation were distinguished. The regime in which flow rates great enough to yield steady level differences of more than 15 μm has been interpreted in terms of a Langer-Fisher type of dissipation, similar to that observed by Liebenberg. The other regime, involving level differences of less than 15 μm, has been attributed to a different mechanism. Both the damping of the inertial oscillations and the associated steady level differences showed satisfactory agreement with the thermal dissipation mechanism originally suggested by Robinson. (MHR)

31193 DIRECT MEASUREMENT OF THE DISSIPATION FUNCTION OF THE FLOWING SATURATED He II FILM. Keller, W. E.; Hammel, E. F. (Los Alamos Scientific Lab., NM). pp 263-267 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Experiments to measure the profile of the chemical potential μ of the saturated liquid He II films as it flows into or out from a cylindrical beaker are described here and it is shown how the results provide a direct measurement of the dissipation function of the system in quantitative agreement with predictions of the thermal fluctuation model of intrinsic dissipation. (MHR)

31194 APPLICATION OF THE FLUCTUATION MODEL OF DISSIPATION TO BEAKER FILM FLOW. Campbell, L. J. (Los Alamos Scientific Lab., NM). pp 268-271 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The starting point for the theory is the recognition that film flow is a steady-state, irreversible process. Therefore dissipation processes must be included. It was found empirically that in isothermal film flow most and possibly all the dissipation can be described by a force per unit mass on the superfluid, which is interpreted as arising from fluctuations which lead to intermediate states (small vortex rings) through which the system can decay to a state of lower free energy. The theory predicts for large flow rates that the film thickness can be constant and thicker than the corresponding static film over a portion of the flow path where the film is descending. (MHR)

31195 FILM FLOW DRIVEN BY VAN DER WAALS FORCES. Blair, D. G.; Matheson, C. C. (Univ. of East Anglia, Norwich, Eng.). pp 272-275 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

To examine film flow driven by van der Waals forces, a film detector is required that combines a large surface area with a narrow flow path for film formation from the helium bath. The experiments began using a torsional oscillator film detector. Unfortunately, the results from the torsional oscillator were difficult to analyze because film formation seemed to be masked by an unexpected effect of the vapor. An automatic ellipsometer is used to measure the helium film thickness of a plain gold substrate which is lifted by means of a superconducting film on a Perspex support in a magnetic field. The thin-film approximation to the Drude equations was used to analyze the ellipsometer data. (MHR)

31196 DECAY OF SATURATED AND UNSATURATED PERSISTENT CURRENTS IN SUPERFLUID HELIUM. Kojima, H.; Veith, W.; Guyon, E.; Rudnick, I. (Univ. of California, Los Angeles). pp 279-282 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Persistent current states in superfluid helium contained in a rotating superleak have been investigated using fourth-sound techniques. These investigations showed that every phenomenon observed in rotating, locked superfluid helium has an analogous counterpart in a highly irreversible, high-field type-II superconductor. Here, some experimental results concerning decay of superfluid helium persistent currents are reported. The results of decay measurements at T = 1.30°K are summarized in which the superfluid component velocity is plotted against log t. It is noted that a part of the decay of unsaturated persistent currents may result from a distribution of superfluid component linear velocity across the finite width (10% of radius) of the annulus. (MHR)

31197 ROTATING COUETTE FLOW OF SUPERFLUID HELIUM. Snyder, H. A. (Univ. of Colorado, Boulder). pp 283-287 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Equations for the flow of He II when $\nabla \times v_s \neq 0$ have been proposed but have not been tested thoroughly. The derivations by Hall and Vinen and by Bekeravich and Khalatnikov (HVBK) are referred to. There are seven terms in these equations which do not appear in the Landau–Khalatnikov equations; they may be attributed to vorticity in the superfluid. The experiment described here is proposed to test the validity of the HVBK equations by testing the seven vorticity terms simultaneously. The Reynolds number at which Taylor vortices (the secondary flow) appear in a double cylinder experiment is determined. The linear stability analysis for rotating Couette flow was formulated using the HVBK equations. A total of 20 normal modes of the cavity were studied as a function of the Reynolds number to determine the position and orientation of the vorticity field in the superfluid. It is concluded that the HVBK equations do not describe the flow of He II adequately in the apparatus. (MHR)

31198 NEW ASPECTS OF THE LAMBDA-POINT PARADOX. Lynch, R. F.; Pellam, J. R. (Univ. of California, Irvine). pp 288-292 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

It is proposed here to eliminate any equipment source for the "λ-point paradox" and to report a newly observed phenomenon dependent on the past history of the liquid helium–disk system. Persistence of the λ-point paradox is shown to be unmistakable. The new phenomenon based upon pressure-cycling the sample termed "zapping" involves the following sequence. Starting from an initial temperature equilibrium at 1.25 K, the liquid helium sample is pressurized rapidly to atmospheric pressure and held at that value for 5 min, whereupon it is again pumped down to 1.25 K. The "zapped" values of deflection are characteristically less than the original values for the otherwise identical state of the system. (MHR)

31199 TORQUE ON A RAYLEIGH DISK DUE TO He II FLOW. Trela, W. J.; Heller, M. (Haverford Coll., PA). pp 293-297 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The Rayleigh disk has been used in several experiments to probe the local velocity field of He II. However, the flow pattern around the disk has not been well understood. Here, a simple model for He II flow past a Rayleigh disk is presented which assumes that superfluid potential flow and normal fluid Helmholtz flow occur. A torque which increases as the temperature decreases below T_λ is predicted. New measurements of the torque on a Rayleigh disk in nonrotating helium are then presented which are in substantial agreement with this model. Finally, it is shown that the model is in agreement with Pellam's Rayleigh disk measurements in rotating helium below T_λ. (MHR)

31200 SUPERFLUID ^{4}He VELOCITIES IN NARROW CHANNELS BETWEEN 1.8 AND 0.3°K. Harrison, S. J.; Mendelssohn, K. (Clarendon Lab., Oxford). pp 298-301 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

An accurate determination was made between 1.8 and 0.3°K of superfluid velocities through submicron pores in irradiated and etched mica sheets of the type first used by Notarys. Good qualitative agreement was found with the Notarys' extension of the Langer–Fisher thermal fluctuation theory for temperatures above 1.0°K and for channel sizes below 2000 Å. Below 1.0°K and for the largest pore size it is suggested that the predominant dissipative mechanism is modified significantly by close vortex spacing. (MHR)

31201 CRITICAL VELOCITIES IN SUPERFLUID FLOW THROUGH ORIFICES. Hess, G. B. (Univ. of Virginia, Charlottesville). pp 302-306 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

A number of recent experiments on the flow of superfluid helium have found an intrinsically limited flow which behaves qualitatively as predicted by Iordanskii and by Langer and Fisher for flow limited by homogeneous nucleation of quantized vortex rings. The predictions of this theoretical model are given. The temperature dependence of the superfluid critical velocity through several pinholes of approximately 10 μm diameter is shown. Attempts to account for the discrepancies with theory are made. An experiment was undertaken to test the prediction that vortex nucleation near the points of contact between solid particles in a flow channel will result in a low and only weakly temperature-dependent critical velocity. (MHR)

31202 OBSERVATIONS OF THE SUPERFLUID CIRCULATION AROUND A WIRE IN A ROTATING VESSEL CONTAINING LIQUID He II. Kral, S. F.; Zimmerman, W. Jr. (Univ. of

Minnesota, Minneapolis). pp 307-310 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Previous observations of the superfluid circulation around a fine wire stretched along the axis of a cylindrical container filled with liquid He II gave rather clear evidence of preferential metastability at quantum levels in the range from −3 to +3 quantum units. These measurements were extended to the case of the wire and container in rotation. The interest was in looking for circulations larger than those seen at rest, in studying the dependence of circulation upon angular velocity of rotation, and in comparing that dependence with the equilibrium predictions of the quantum vortex model for superfluid rotation. Here measurements of the circulation in rotation at angular velocities up to 4 rad sec^{-1} in magnitude were made at temperatures between 1.2 and 1.4°K. (auth)

31203 ATTEMPT TO PHOTOGRAPH THE VORTEX LATTICE IN ROTATING He II. Packard, R. E.; Williams, G. A. (Univ. of California, Berkeley). pp 311-313 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Electrons produced in the liquid by a radioactive source form microscopic bubbles which can be trapped on the vortex lines. On the application of an electric field along the axis of the line, the electron emerges from the liquid through the meniscus. The charge is then accelerated by a high voltage and finally strikes a phosphor screen thus marking the position of the line with a flash of light. In this way the spatial arrangement of the vortex lines could be recorded by photographing the image on the phosphor. The problems involved and the unsuccessful results are discussed. (MHR)

31204 RADIAL DISTRIBUTION OF SUPERFLUID VORTICES IN A ROTATING ANNULUS. Shenk, D. S.; Mehl, J. B. (Univ. of Delaware, Newark). pp 314-318 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

An annular geometry is convenient for theoretical and experimental studies of the equilibrium state of superfluid helium in a rotating container. Studies of the radial distribution of superfluid vortices in annuli with widths of 1.27 and 0.75 mm are reported. Standing waves of second sound were used as probes of the vortex distribution. (auth)

31205 EFFECT OF A CONSTRICTION ON THE VORTEX DENSITY IN He II SUPERFLOW. Francois, M. (Paris Univ., Orsay, France); Lhuillier, D.; Le Ray, M.; Vidal, F. pp 319-323 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The vortex density in the flow is analyzed by measuring the extra attenuation $\alpha' = \alpha - \alpha_0$ (α_0 is the static attenuation) of a second-sound resonant wave. In the experiments the superflow, thermomechanically driven by a heater, goes from the second-sound resonator to the constriction and thus the second sound always probes the vortex density in the part of the tube which is beyond the constriction. (MHR)

31206 ac MEASUREMENTS OF A COUPLING BETWEEN DISSIPATIVE HEAT FLUX AND MUTUAL FRICTION FORCE IN He II. Vidal, F. (Ecole Normale Superieure, Paris); Le Ray, M.; Francois, M.; Lhuillier, D. pp 324-327 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Previous measurements on the variation of second-sound velocity in the presence of superfluid vortices suggest the existence of a coupling between the dissipative heat flux and the mutual friction force. The latest results on the second-sound measurements and preliminary results on the fourth-sound velocity in presence of a supercritical superflow are presented. (MHR)

31207 He II−He I TRANSITION IN A HEAT CURRENT. Bhagat, S. M.; Davis, R. S.; Lasken, R. A. (Univ. of Maryland, College Park). pp 328-331 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The results of two sets of experiments designed to measure the temperature at which He II and He I will be in equilibrium when a steady heat current is flowing through the fluid are presented. (MHR)

31208 PUMPING IN He II BY LOW-FREQUENCY SOUND. Watson, G. E. (American Univ. of Beirut). pp 332-336 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Since the first successful demonstration of the analog of the Josephson effect in helium, there have been several improvements of this experiment. In all of these experiments a pumping effect has been observed where the helium is pumped toward the crystal generator. Here, a pumping effect has been observed that seems to have rather different characteristics, among them, pumping in both directions. (MHR)

31209 OPTICAL MEASUREMENTS ON SURFACE MODES IN LIQUID HELIUM II. Cunsolo, S.; Jacucci, G. (Univ. Degli Studi, Rome). pp 337-340 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements in a much shorter wavelength region than 1 mm may be carried out with a light-beating technique based on the scattering of coherent light by excited surface waves. Seeking to check at higher frequencies the hydrodynamic predictions for the dispersion relation of these modes at various values of the depth of the liquid and thickness of the film, one such apparatus was set up. Here preliminary results regarding the surface waves on bulk liquid helium are reported. (MHR)

31210 MEASUREMENT OF THE TEMPERATURE DEPENDENCE OF THE DENSITY OF LIQUID ^{4}He FROM 0.3 TO 0.7°K AND NEAR THE LAMBDA-POINT. Van Degrift, C. T.; Pellam, J. R. (Univ. of California, Irvine). pp 343-347 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Preliminary measurements are reported of the temperature dependence of the dielectric constant at saturated vapor pressure from 0.3 to 0.7°K and in the region within 10 m°K of the λ-point. These measurements were made using an improved tunnel diode oscillator circuit. The sensitivity was such that density changes as small as 0.05 ppm could be resolved. Here, the temperature resolution was not sufficiently precise to take full advantage of this sensitivity. (MHR)

31211 SECOND-SOUND VELOCITY AND SUPERFLUID DENSITY IN ^{4}He UNDER PRESSURE AND NEAR T_λ. Greywall, D. S.; Ahlers, G. (Bell Telephone Labs., Murray Hill, NJ). pp 348-351 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Values of the superfluid fraction ρ_s/ρ which were derived from precise measurements of the second-sound velocity u_2 in pure ^{4}He are presented. These results extend to temperatures very near the superfluid transition temperature T_λ and cover the entire pressure range over which the superfluid exists. The results are consistent with both scaling and universality. (MHR)

31212 SUPERFLUID DENSITY NEAR THE LAMBDA POINT IN HELIUM UNDER PRESSURE. Ikushima, A.; Terui, G. (Tokyo Univ.). pp 352-355 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The change of the critical exponent of the superfluid density as a function of the pressure is reported. The superfluid density was deduced from the second-sound velocity determined by measuring the resonant frequencies of the CW second-sound in a cavity and by using previously published data of the specific heat and the entropy. (MHR)

31213 HYPERSONIC ATTENUATION IN THE VICINITY OF THE SUPERFLUID TRANSITION OF LIQUID HELIUM. Commins, D. E.; Rudnick, I. (Univ. of California, Los Angeles). pp 356-358 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The attenuation of first sound was measured at a frequency of 1 GHz and the temperature was measured with greater accuracy. A fixed-path interferometer, using a pair of cadmium sulfide transducers, was weakly thermally linked to the main helium bath by a partial vacuum and its temperature was allowed to drift at rates as slow as 3×10^{-6} °K sec^{-1}. The temperature of the helium sample was measured in the immediate vicinity of the acoustic field. The temperature and amplitude of the received acoustic signal were simultaneously recorded. The recordings demonstrate that the attenuation maximum occurs below the lambda temperature. Several slow drifts were performed upward as well as downward and the amplitude of the input signal as well as the pulse repetition frequency were widely varied without any noticeable change in the results. The maximum absorption occurs 3.26 ± 0.20 m°K below T_λ confirming with greater accuracy the earlier results. (MHR)

31214 SUPERHEATING IN He II. Childers, R. K.; Tough, J. T. (Ohio State Univ., Columbus). pp 359-363 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

It is concluded that superheating of He II does occur. The production of the metastable superheated state is made possible in this experiment by the nonlinear thermomechanical properties of the He II in the thin connecting tube. Failure to observe superheating in previous experiments probably is a result of excessive vibration in the apparatus. (MHR)

31215 EVAPORATION FROM SUPERFLUID HELIUM. Cole, M. W. (Univ. of Toronto). pp 364-366 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

It has been found for superfluid helium that the liquid-vapor interface plays a mediating role in the microscopic process of evaporation which tends to obscure information about properties of the bulk liquid. However, in so doing, it allows one to obtain information about the surface which is also of intrinsic interest. This model assumes that the evaporation process occurs when a single quasi-particle arrives at the surface and transfers all of its energy to an atom, which enters the vapor region. (MHR)

31216 ANGULAR DISTRIBUTION OF ENERGY FLUX RADIATED FROM A PULSED THERMAL SOURCE IN He II BELOW 0.3°K. Pfeifer, C. D. (Univ. of Wisconsin, Madison); Luszczynski, K. pp 367-371 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. C. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

This experiment was designed to measure the angular distribution of excitations emitted by two heaters with different surfaces over a wide range of heater power densities to provide further information concerning the flow of energy from heated solids to low-temperature He II. (MHR)

31217 ELECTRIC FIELD AMPLIFICATION OF He II LUMINESCENCE BELOW 0.8°K. Roberts, H. A.; Hereford, F. L. (Univ. of Virginia, Charlottesville). pp 372-376 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements of the intensity of the total luminescence (time integrated) as well as the pulse intensity ($\tau = 1.25 \times 10^{-6}$ sec) for temperatures down to 0.3°K are reported, and the effect of an electric field applied in the region of the alpha-particle "tracks" is studied. The results show that the variation of the total intensity with temperature and its behavior under an applied field are strikingly different from the corresponding variations of the pulse intensity. (MHR)

31218 CORRELATION LENGTH AND COMPRESSIBILITY OF ^{4}He NEAR THE CRITICAL POINT. Tominaga, A.; Narahara, Y. (Tokyo Univ. of Education). pp 377-380 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements of the light scattering at a right angle by ^{4}He near the critical point T_c were made as a function of temperature. From these measurements the critical index γ', which characterizes the temperature dependence of the isothermal compressibility times the density squared along the liquid side of the coexistence curve, was estimated, and the correlation length of helium was also derived as a function of temperature. (MHR)

31219 COEXISTENCE CURVE AND PARAMETRIC EQUATION OF STATE FOR ^{4}He NEAR ITS CRITICAL POINT. Kierstead, H. A. (Argonne National Lab., IL). pp 381-386 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The pressure coefficient $(\partial P/\partial T)$ was measured along 29 isochores in the density range $-0.2 < \Delta\rho < 0.2$ and the temperature range $-0.2 < t < 0.032$, where $\Delta\rho = (\rho - \rho_c)/\rho_c$ and $t = (T - T_c)/T_c$. The apparatus and experimental techniques were the same as were used in the previous study of the critical isochore. (MHR)

31220 EFFECT OF VISCOSITY ON THE KAPITZA CONDUCTANCE. Saslow, W. M. (Texas A and M Univ., College Station). pp 387-392 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Certain idealizations are made in theoretical calculations of the Kapitza conductance. One set pertains to the solid: It is usually taken to be perfectly smooth and regular, so that it is described by a continuum model for the lattice vibrations. In addition, the solid is taken to be isotropic. A transverse response is included in order to determine its effects on the energy transfer between solids and liquid helium. A source of energy which is available for transfer from liquid to solid is pointed out, and with the aid of model calculations it is shown that it can be sufficiently large to explain the measured values of the Kapitza conductance. It is shown that this description of the liquid (and perhaps the solid) must be made more complex. (MHR)

31221 LIQUID DISORDER EFFECTS ON THE SOLID He II KAPITZA RESISTANCE. Linnet, C.; Frederking, T. H. K.; Amar, R. C. (Univ. of California, Los Angeles). pp 393-397 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Experiments were conducted at heat fluxes of the order of magnitude 0.5 to 5 W cm^{-2} with the purpose of resolving further details of the liquid He II thermohydrodynamic aspects of the solid-He II Kapitza resistance. The results indicate that the He II thermohydrodynamics near thin cylinders is affected strongly by the size. They appear to support the possibility that Kapitza resistance departures from phonon transmission laws might be traced in part to liquid impedances. Examples are the pitted surface and porous coatings. (MHR)

31222 KAPITZA RESISTANCE BETWEEN Cu(Cr) AND ^{4}He(^{3}He) SOLUTIONS AND APPLICATIONS TO HEAT EXCHANGERS. Siegwarth, J. D.; Radebaugh, R. (National Bureau of Standards, Boulder, CO). pp 398-400 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The Kapitza boundary resistance between various copper cells and the dilute stream of a dilution refrigerator were measured by a continuous flow technique. The Kapitza resistances of work-hardened copper and annealed copper to pure ^{3}He are shown for comparison purposes. The measurement of the Kapitza resistance between annealed OFHC copper and the dilute ^{3}He stream of the dilution refrigerator is given. A Cu(Cr) cell was solution-treated in hydrogen and briefly in a small amount of air at 950°C, held at 750°C in a hydrogen atmosphere to simulate sintering, and then aged at 450°C for 4½ hr in a forepump vacuum. A second cell was aged at 435°C for 17 hr in hydrogen but never heated above this after the initial melting. Two more cells were made to test if oxygen annealing of the chromium could result from aging in oxygen. The resistance was measured for Cu–30% Ni and Cu(Zr). (MHR)

31223 HEAT TRANSFER BETWEEN FINE COPPER POWDERS AND DILUTE ^{3}He IN SUPERFLUID ^{4}He. Radebaugh, R.; Siegwarth, J. D. (National Bureau of Standards, Boulder, CO). pp 401-405 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Anomalously high values for the Kapitza resistance were looked for in sintered copper powders of 27, 20, and 2 μm diame-

ter and were found. The results were in semiquantitative agreement with Seiden's calculations on the phonon–electron resistance. Here, a reanalysis of some of the authors' earlier work is discussed, along with new data which cast doubt upon the interpretation that the phonon–electron resistance was responsible for the observed high resistance. (MHR)

31224 THERMAL BOUNDARY RESISTANCE BETWEEN Pt AND LIQUID ^{3}He AT VERY LOW TEMPERATURES. Bishop, J. H.; Mota, A. C.; Wheatley, J. C. (Univ. of California, San Diego, La Jolla). pp 406–410 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Data are presented which suggest that the thermal boundary resistance between Pt and liquid ^{3}He is qualitatively different from the phonon and magnetic boundary resistances. (MHR)

31225 LEGGETT–RICE EFFECT IN LIQUID ^{3}He SYSTEMS. Corruccini, L. R.; Osheroff, D. D.; Lee, D. M.; Richardson, R. C. (Cornell Univ., Ithaca, NY). pp 411–413 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Spin-echo data were obtained for liquid ^{3}He at pressures of zero and 27 atm and for a 6.4% ^{3}He–^{4}He solution at P = 0. Data were taken as a function of initial pulse angle ϕ, temperature T, and field gradient G. The highest Larmor frequency attained was 36.7 MHz, and the lowest temperature about 6 m°K, well within the collisionless regime for all three samples. Cooling was provided by a Pomeranchuk effect ^{3}He compression cell. Within experimental accuracy the observed echo attenuation is described accurately by Leggett's equation. (MHR)

31226 HELIUM FLOW THROUGH AN ORIFICE IN THE PRESENCE OF AN ac SOUND FIELD. Musinski, D.; Douglass, D. H. (Univ. of Rochester, NY). pp 414–418 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

An attempt to observe the ac Josephson effect in liquid helium is reported. Previously positive observation of the effect by monitoring the level difference between two baths separated by a small orifice was reported. The experiment was designed so that a temperature difference could be introduced and measured as well. In this work both the gravitational and entropy terms are considered in detail. Stable states of zero flow through an orifice in the presence of an ac sound field which are clearly not the Josephson effect are found. These states depend on the total height of the fluid in the inner bath and not on the level difference. In addition they are insensitive to a temperature difference for small differences. Careful inspection of the various curves yielded no evidence for the ac Josephson effect. (MHR)

31227 VORTEX FLUCTUATION CONTRIBUTION TO THE NEGATIVE ION TRAPPING LIFETIME. McCauley, J. Jr. (Yale Univ., New Haven). pp 421–425 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

In early work on the trapping of negative ions by vortex lines in He II, it was noted that the trapping lifetime did not exhibit quite the right temperature dependence required by experiment. A thermodynamic analysis of the discrepancy is given using the quantum hydrodynamic model of a vortex line first suggested by Fetter (Phys. Rev. 162, 143 (1967)). (MHR)

31228 QUESTION OF ION CURRENT FLOW IN HELIUM FILMS. Kennedy, S. G.; Gribbon, P. W. F. (Univ. of St. Andrews, Scotland). pp 426–429 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Previously some observations were reported which suggest that an ion current could exist in the saturated film of He II. The film existed on the insulated dielectric surfaces above the gas–liquid interface in an ion cell. The possibility of a current in the gas rather than in the film was ruled out, but here the validity of this conclusion is questioned. The ion currents were measured as a function of temperature from 0.9 to 4.2°K for various applied electric fields from 10 V cm^{-1} to 200 V cm^{-1} in both Perspex and glass-walled diode and triode cells. No conclusive evidence was found for a current flow in a saturated film of He II. (MHR)

31229 IMPURITY ION MOBILITY IN He II. Johnson, W. W.; Glaberson, W. I. (Rutgers–The State Univ., New Brunswick, NJ). pp 430–433 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

A detailed examination of mobilities of ^{40}Ca and ^{48}Ca ions so as to isolate the effects of ionic mass on mobility is reported, and the data are discussed in terms of recent theories of roton-limited ion mobility. The experimental procedure involves producing a continuous electrical discharge in helium vapor above the liquid level. (MHR)

31230 MEASUREMENT OF IONIC MOBILITIES IN LIQUID ^{3}He BY A SPACE CHARGE METHOD. McClintock, P. V. E. (Univ. of Lancaster, Eng.). pp 434–438 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Mobility measurements down to 0.25°K by space-charge-limited emission of ions from a sharp metal point are described. This method appears to be more accurate than earlier space charge techniques and avoids the complication of thermal gradients due to heating at a radioactive source. Between 0.25 and 2.0°K the mobilities of both positive and negative ions in liquid ^{3}He at low pressure are independent of electric field up to several kV cm^{-1}. For negative ions the results are in excellent agreement with the earlier work. For positive ions they are not in disagreement but, with superior resolution, a definite minimum in μ_+ was observed at around 0.3°K. (MHR)

31231 PRESSURE DEPENDENCE OF CHARGE CARRIER MOBILITIES IN SUPERFLUID HELIUM. Ostermeier, R. M.; Schwarz, K. W. (Univ. of Chicago). pp 439–442 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Accurate and extensive measurements were made of the mobility of positive and negative charge carriers in ^{4}He at pressures up to the melting pressure and temperatures in the range 0.27 T 1 K. The data are analyzed in terms of the scattering of phonons and rotons by the carriers. The phonon-dominated mobility of the negatives agrees well with existing theories, and analysis of the results provides a new determination of the electron bubble radius as a function of pressure. The phonon term for the positives is calculated from the electrostriction model and is in good agreement with the experimental results. (MHR)

31232 TWO-DIMENSIONAL ELECTRON STATES OUTSIDE LIQUID HELIUM. Brown, T. R.; Grimes, C. C. (Bell Telephone Labs., Murray Hills, NJ). pp 443–446 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Cyclotron resonance (CR) was observed from electrons in two-dimensional (2D) surface states outside liquid helium. Their 2D character is shown by the fact that the cyclotron resonant frequency depends only on the component of the applied magnetic field perpendicular to the surface. These observations have been made outside both bulk liquid helium and films of liquid helium covering a dielectric substrate. For the case of bulk helium the surface mobility of the electrons was determined from the CR linewidths and reasonable agreement was found with a simple calculation of the mobility assuming the electrons can scatter only parallel to the surface. (MHR)

31233 EXPERIMENTAL TEST OF VINEN'S DIMENSIONAL THEORY OF TURBULENT He II. Sitton, D. M. (Univ. of Virginia, Charlottesville); Moss, F. E. pp 447–450 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Below 1.75 K anomalously large values of the escape probability P were measured. In order to further investigate this effect and to observe the pressure dependence of P, the space-charge-limited diode current from an 8-Ci tritium ion source was studied. It is concluded that Vinen's dimensional theory is correct in its essential features, and that vortex annihilation is driven by the normal fluid flow through the Magnus effect in well-developed turbulence. Finally, it is concluded that the pressure dependence of P in turbulent He II is consistent with observations on rotating He. (MHR)

31234 MEASUREMENTS ON IONIC MOBILITIES IN LIQUID ^{4}He. Daalmans, G. M.; Naeije, M.; Goldschvartz, J. M.; Blaisse,

B. S. (Delft Univ. of Tech., Netherlands). pp 451-455 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The ionic mobilities were measured in liquid helium in the temperature range 1.25 to 4.24 K. The method used is based on the measurement of the pressure generated by ions moving in an electric field. Two electrodes were melted, one flat and one pin-shaped, in a glass tube which is open on both ends. Creation of ions takes place in the neighborhood of and at the very sharp tungsten electrode under the influence of a potential difference of 6 to 30 kV. The pressure generated inside the glass tube was measured as a level difference between the liquid helium levels inside and outside the tube. A relation for the ionic current is given by application of a force balance. (MHR)

31235 INFLUENCE OF A GRID ON ION CURRENTS IN He II. Doake, C. S. M.; Gribbon, P. W. F. (Univ. of St. Andrews, Scotland). pp 456-458 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Some work on the interaction of bare ions and charged vortex rings with grid electrodes of different mesh size is presented. Measurements were made on the dc characteristic of grids mounted in triode and tetrode cells in He II at temperatures near 1°K and at pressures up to 7 atm. (MHR)

31236 COLLECTIVE MODES IN VORTEX RING BEAMS. Gamota, G. (Bell Telephone Labs., Murray Hill, NJ). pp 459-468 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Phenomena arising from the mutual interactions among charged vortices are investigated. Plasmalike effects are sought that can be found in a gas made up of individual charged vortex rings. It was shown that collective modes exist in a beam of charged vortices in superfluid helium. The characteristics of these waves agree with theoretical predictions for low frequencies. Changing the density of the beam, beam energy, and drift space allowed us to determine the various parameters pertinent to the theory and good agreement was found. (MHR)

31237 TUNNELING FROM ELECTRONIC BUBBLE STATES IN LIQUID HELIUM THROUGH THE LIQUID–VAPOR INTERFACE. Rayfield, G. W.; Schoepe, W. (Univ. of Oregon, Eugene). pp 469-473 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Ions have been extensively used in liquid helium to study both the superfluid and normal states. Negative ions (electronic bubbles) pass into the vapor quite easily, providing the temperature is not too low ($T > 2°K$). As the temperature is lowered, negative ions experience a rapidly increasing difficulty in penetrating the free surface, resulting in a vanishing current at moderate electric fields below 1°K. As the negative ion approaches the free surface it encounters an image-induced potential well. The experimental cell used to measure this exponential decay of the current is shown. Near the free surface the electrons can escape from these tiny spherical bubbles by tunneling. Calculated and measured trapping times are shown as a function of temperature for various electric fields across the free surface of liquid ^4He. The results of the present experiments on pure ^3He and pure ^4He are summarized. (MHR)

31238 POSITIVE ION MOBILITY IN LIQUID ^3He. Kuchnir, M.; Ketterson, J. B.; Roach, P. R. (Argonne National Lab., IL). pp 474-476 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

An improved time-of-flight technique and a dilution refrigerator were used for the present set of measurements. Only data taken above 0.15 K are reported. It is suggested that the shape of the mobility minimum is related to the layered model proposed by Johnson and Glaberson. (MHR)

31239 LARGE FAMILY OF NEGATIVE CHARGE CARRIERS IN LIQUID HELIUM. Ihas, G. G.; Sanders, T. M. Jr. (Univ. of Michigan, Ann Arbor). pp 477-481 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D., (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

A negative charge carrier was found with a much higher mobility than either the normal positive or negative carrier studied for the past fifteen years. It was found that this new species, rather than producing vortex rings, reached a velocity apparently limited by roton creation. Here a new species was studied having similar characteristics and it was found that a large family of negative charge carriers can be produced in liquid helium. It is thought that the following models may be eliminated: free (conduction band) electron, excited and multiple electron bubble states, and ^3He-dependent states. (MHR)

31240 TEMPERATURE DEPENDENCE OF THE ELECTRON BUBBLE MOBILITY BELOW 0.3°K. Kuchnir, M.; Ketterson, J. B.; Roach, P. R. (Argonne National Lab., IL). pp 482-484 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The temperature dependence of the mobility of the electron bubble in superfluid helium has been calculated previously using a hydrodynamic approach for the phonon-bubble scattering cross section. This calculation predicts that the mobility at lower temperatures should rise more sharply than T^{-3}. Here, the measured temperature range is extended down to 0.15 K and it is observed that the mobility indeed increases faster than T^{-3}. The method used to measure the time of flight employs a fast electrometer. (MHR)

31241 TRANSPORT PROPERTIES OF ELECTRON BUBBLES IN LIQUID He II. Date, M.; Hori, H.; Toyokawa, K.; Wake, M.; Ichikawa, O. (Osaka Univ.). pp 485-488 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Thermal electrons can be injected into the He II bath by heating tungsten filament immersed in the liquid. This method is useful for studying electron bubbles because it can supply a large quantity of electrons. The process in the vicinity of the wire resembles film boiling when the He depth is shallow or the temperature is high, while it results in a quiescent vapor bubble or a gas sheath in the deep bath at low temperature. An attempt was made to estimate the effective radius of the gas sheath by using microwave techniques. Although it is not yet clear that the gas sheath exists in a definite form, the mechanical, thermal, and electrical properties of various phenomena associated with the hot filament in He II are explained on the gas sheath model. The electrical properties of injecting electrons were investigated by making a diode and a triode. (MHR)

31242 DO FLUCTUATIONS DETERMINE THE ION MOBILITY IN He II NEAR T_λ. Sitton, D. M. (Univ. of Virginia, Charlottesville); Moss, F. E. pp 489-492 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements of the zero-field ionic mobility μ in the roton region and near T_λ of superfluid helium have been obtained from the characteristics of space-charge-limited discharges. The results for negative ions were obtained from the dc current $I = C\mu V^2$ of a planar diode using an 8-Ci tritium ion source. The source was plated on a 1-in.-diameter by 0.005-in.-thick OFHC copper disk which faced a collector which ensured space charge limitation for currents measured. The geometric constant C was determined by matching the data to a known value of μ at a single temperature. The results for positive ions were obtained from tungsten field emission points. Over the range from 1.4°K to T_λ tabular comparison with Schwarz's data shows a point-by-point variation of no more than ±1%. (MHR)

31243 ABSENCE OF A QUADRATIC TERM IN THE ^4He EXCITATION SPECTRUM. Roach, P. R.; Abraham, B. M.; Ketterson, J. B.; Kuchnir, M. (Argonne National Lab., IL). pp 493-496 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

In an attempt to measure the dispersion in a way that is independent of temperature effects and of possible peculiarities of He films, the dispersion was measured in bulk ^4He below 100 m°K to an accuracy sufficient to allow the observation of a linear term if it is as large as predicted. The method involves the direct measurement of the difference in velocity of simultaneous 30- and 90-MHz sound waves in the liquid. To obtain the required accuracy,

the 30- and 90-MHz oscillators are phase-locked to each other so that the relative phase delay of the two signals after they have passed through the helium can be directly measured. Since it is only feasible to determine changes in this relative delay, the delay was measured as a function of sound path length which is varied by moving a reflector in the helium. (MHR)

31244 THEORETICAL STUDIES OF THE PROPAGATION OF SOUND IN CHANNELS FILLED WITH HELIUM II. Wiechert, H.; Schubert, G. U. (Johannes Gutenberg Univ., Mainz). pp 497-500 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The two-fluid nature of liquid helium II leads to the possibility of several types of wave motion, e.g., first sound, second sound, fourth sound, and the fifth wave mode. First and second sound appear in the bulk liquid. The characters of these wave modes alter materially if helium is bounded by solid walls, e.g., between two plane-parallel plates forming a channel. The calculation of the properties of wave modes which can exist in such channels is reported. The theory is based on the complete linearized set of the thermohydrodynamic equation, the so-called Khalatnikov equations. (MHR)

31245 DEVELOPMENTS IN THE THEORY OF THIRD SOUND AND FOURTH SOUND. Bergman, D. J. (Tel-Aviv Univ., Israel). pp 501-509 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

In narrow channels filled with helium II two wave modes propagate, fourth sound and the fifth wave mode. Here, it is experimentally verified that it is also possible to excite fourth sound thermally. Since the theory gives the result that fourth sound can be generated thermally only if the fifth-wave mode is taken into account, the detection of a thermally excited fourth-sound signal is also a first indirect proof for the existence of the fifth-wave mode. (MHR)

31246 THERMAL EXCITATION OF FOURTH SOUND IN LIQUID HELIUM II. Wiechert, H.; Schmidt, R. (Johannes Gutenberg Univ., Mainz). pp 510-514 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

In narrow channels filled with helium II two wave modes propagate, fourth sound and the fifth wave mode. According to new results of theoretical studies, it has been predicted that it should be possible to excite both wave modes mechanically by vibrating the diaphragm of a condenser microphone as well as thermally by periodically heating the surface of a solid body (e.g., a resistance layer). Fourth-sound signals have been produced and detected mechanically. Here, it is experimentally verified that it is also possible to excite fourth sound thermally. Since the theory gives the result that fourth sound can be generated thermally only if the fifth-wave mode is taken into account, the detection of a thermally excited fourth-sound signal is also a first indirect proof for the existence of the fifth-wave mode. (MHR)

31247 INELASTIC SCATTERING FROM SURFACE ZERO-SOUND MODES: A MODEL CALCULATION. Griffin, A.; Zaremba, E. (Univ. of Toronto). pp 515-517 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

In dealing with density oscillations near a planar boundary, some choice must be made on dealing with the static part of the problem and the dynamic part of the problem. In the present model calculations, the interest is in relatively high-frequency collisionless modes and it is argued that one may treat the boundary (whether a wall or a free liquid surface) in terms of a high potential barrier which gives rise to simple specular scattering. For the dynamics, the well-known self-consistent field approximation (or RPA) appropriate to a degenerate Fermi system is used. The quantum mechanical interference effects for particles bounding off the surface are neglected. Formally, the calculations involve extending the usual discussions of surface modes in an electron gas to the case of neutral systems interacting via a short-range Yukawa potential. The model calculations are of interest for liquid ^{3}He. In fact, the calculations may be interpreted in terms of Fermi liquid theory for a contact potential and the strong coupling limit. (MHR)

31248 SCATTERING OF LOW-ENERGY HELIUM ATOMS AT THE SURFACE OF LIQUID HELIUM. Eckardt, J.; Edwards, D. O.; Gasparini, F. M.; Shen, S. Y. (Ohio State Univ., Columbus). pp 518-521 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

An atomic beam experiment was designed to be performed at low temperature in order to study the scattering of helium atoms at the liquid surface. The experimental cell consists of a metal can about 9 cm in diameter and 17 cm high which is cooled by a dilution refrigerator to ~0.030°K. The can houses two superconducting motors which can move two graphite film resistors at a radius of 4.1 cm so as to vary their angle relative to the liquid surface. Each resistor can be used interchangeably as an emitter or a receiver. Control experiments were done in which the cell contained just enough helium to produce a saturated film. Under such condition the direct radiation of atoms from the heater to the receiver was studied. The angular distribution of atoms emitted from the heater was studied. (MHR)

31249 INELASTIC SCATTERING OF ^{4}He ATOMS BY THE FREE SURFACE OF LIQUID ^{4}He. Kuper, C. G. (Technion-Israel Inst. of Tech., Haifa). pp 522-523 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

An experiment designed with the intention of measuring the accommodation coefficient of ^{4}He is outlined. The preliminary results are discussed and a hydrodynamic picture given for them. (MHR)

31250 SCATTERING OF LIGHT BY LIQUID ^{4}He CLOSE TO THE LAMBDA-LINE. Vinen, W. F. (Univ. of Birmingham, Eng.); Palin, C. J.; Vaughan, J. M. pp 524-531 of Low Temperature Physics: Lt 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Progress is reported toward the use of the scattering of visible light by liquid ^{4}He as a tool in the experimental investigation of the λ-transition. Two types of optical measurement were made: the total scattered intensity and the spectrum of the scattered light. In the former case scattered light is focused directly onto the photocathode of a photomultiplier connected to a counter; a "normalized scattered intensity" is then obtained by dividing the count rate by the output of a photodiode which continuously monitors the intensity of the incident laser beam. In the latter case the scattered light is analyzed with a scanning Fabry–Perot interferometer, for which the instrumental line broadening is about 6 MHz (fwhh). (MHR)

31251 EXPERIMENTS ON THE SCATTERING OF LIGHT BY LIQUID HELIUM. Vaughan, J. M. (Royal Radar Establishment, Malvern, Eng.); Vinen, W. F.; Palin, C. J. pp 532-536 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The Malvern-Birmingham groups have conducted light scattering experiments on liquid helium in a number of different regimes: Rayleigh and Brillouin scattering from superfluid mixtures of ^{3}He–^{4}He, from normal and superfluid ^{4}He, second order Raman scattering from ^{4}He above the λ-point, and total intensity measurements close to the λ-line. The spectroscopic equipment used in recent studies is described and the results of attenuation and velocity measurements of first sound close to the λ-line at elevated pressure and a frequency close to 1 GHz. These latter results relate well in their general form with previous measurements at SVP and show a velocity minimum and attenuation maximum several millidegrees below the λ-point. (MHR)

31252 BRILLOUIN LIGHT SCATTERING FROM SUPERFLUID HELIUM UNDER PRESSURE. Winterling, G.; Holmes, F. S.; Greytak, T. J. (Massachusetts Inst. of Tech., Cambridge). pp 537-541 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Brillouin scattering was used to study both thermally excited first and second sound in pure liquid ^{4}He at a pressure of 25 atm. The high-frequency velocity and damping of both modes was measured at a wavelength of 4.34×10^{-5} cm and at temperatures between 1.4 and 2.2°K. The ratio of the intensity of the light

scattered from second sound to that scattered from first sound has also been determined and is reported here for the temperature region $10^{-3} < T_\lambda - T < 10^{-1}$°K. (MHR)

31253 BRILLOUIN SCATTERING FROM SUPERFLUID ^{3}He–^{4}He MIXTURES. Benjamin, R. F.; Rockwell, D. A.; Greytak, T. J. (Massachusetts Inst. of Tech., Cambridge). pp 542-546 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Brillouin scattering was used to study thermally excited first sound, second sound, and concentration fluctuations in superfluid ^{3}He–^{4}He mixtures. The spectrum of the scattered light consists of five lines. The ^{3}He–^{4}He mixtures were contained in a copper cell which was cooled by a ^{3}He refrigerator. Measurements were made on two different molar concentrations: × 0.05 and 0.135. Temperatures ranged from 0.4 to 1.2 K. (MHR)

31254 LIQUID STRUCTURE FACTOR MEASUREMENTS ON THE QUANTUM LIQUIDS. Hallock, R. B. (Univ. of Massachusetts, Amherst). pp 547-550 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Data obtained from recent experiments in which Cu Kα (1.54 Å) X rays were scattered from liquid ^{3}He were analyzed. The liquid structure factor S was determined as a function of momentum transfer k in two completely independent scattering experiments. The present results support the earlier conclusions that the gentle change in slope of S(k) seen in ^{4}He is not a consequence of the particular quantum statistics involved. (MHR)

31255 FUNCTIONAL FORMS OF S(k) AND E(k) IN He II AS DETERMINED BY SCATTERING EXPERIMENTS. Hallock, R. B. (Univ. of Massachusetts, Amherst). pp 551-555 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The detailed form of the dispersion relation in He II has recently been the subject of intense interest. The present discussion was motivated by the work of Molinari and Regge in which they suggested that the dispersion curve in He II might possess a term quadratic in the momentum. In the work described here, fits to the data of Cowley and Woods were carried out, but attention is restricted to the small-angle data (k 1.0 A^{-1}). (MHR)

31256 EFFECTIVE VISCOSITY OF LIQUID HELIUM ISOTOPE MIXTURES. Betts, D. S.; Brewer, D. F.; Lucking, R. (Univ. of Sussex, Brighton, Eng.). pp 559-562 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Recently results were reported on the effective viscosity of dilute mixtures ($X_3 < 10\%$) between 20 m°K and 1°K. Here, the ranges of concentration were extended up to $X_3 = 100\%$ and of temperature up to 2°K so that all accessible areas of the phase diagram have now been investigated. Only in the region of the tricritical point have serious difficulties been encountered. To derive the viscosity, the logarithmic decrement of torsional oscillations of a cylindrical quartz crystal immersed in the liquid was measured. (MHR)

31257 VISCOSITY OF DILUTE SOLUTIONS OF ^{3}He IN ^{4}He AT LOW TEMPERATURES. Kuenhold, K. A.; Crum, D. B.; Sarwinski, R. E. (Ohio State Univ., Columbus). pp 563-567 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Viscosities of dilute solutions having concentrations from 0.1% to 7.0% ^{3}He in ^{4}He over the temperature range 0.03 to 0.9°K were measured. The measurements were made using the conventional technique of allowing the liquid to flow between two thermally connected reservoirs through a capillary of known impedance. The viscosity for different values of concentration is shown as a function of temperature. Theory and measurements of viscosities by a number of experimenters are compared with this work for concentration X ~1.3% and 5%. (MHR)

31258 VISCOSITY OF ^{3}He–^{4}He SOLUTIONS. Fisk, D. J.; Hall, H. E. (Univ. of Manchester, Eng.). pp 568-570 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The viscosity of 1.3%, 3.5%, and 5% solutions of ^{3}He in ^{4}He from 25 m°K to 0.5°K was measured with a vibrating wire viscometer of the type used previously for measurements on pure ^{3}He, operating at a frequency of the order of 200 Hz. The major change to the apparatus for the present measurements was that a pill of powdered CMN immersed in the solution was used as a primary thermometer. The half-height points of the wire resonance were measured by the "45° null" method. The results are compared with theory. (MHR)

31259 THERMODYNAMIC PROPERTIES OF LIQUID ^{3}He–^{4}He MIXTURES NEAR THE TRICRITICAL POINT DERIVED FROM SPECIFIC HEAT MEASUREMENTS. Islander, S. T. (Helsinki Univ. of Tech., Finland); Zimmerman, W. Jr. pp 571-575 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Previously the results were presented of some measurements of the specific heat of liquid ^{3}He/^{4}He mixtures at saturated vapor pressure near the junction of the lambda and phase-separation curves which occurs at a temperature $T_0 \cong 0.87$ K and a ^{3}He mole fraction $x_3 \cong 0.67$. Here, it is proposed to indicate some of the possibilities for determining a variety of thermodynamic information about the junction region from the specific heat data. (MHR)

31260 DIELECTRIC CONSTANT AND VISCOSITY OF PRESSURIZED ^{3}He–^{4}He SOLUTIONS NEAR THE TRICRITICAL POINT. Lai, C. M. (Brookhaven National Lab., Upton, NY); Kitchens, T. A. pp 576-580 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Measurements of the dielectric constant ϵ and the product of the normal density ρ_n and the viscosity η were made on ^{3}He–^{4}He solutions at pressures up to the solidus. In this experiment both $\rho_n\eta$, determined from the damping on a vibrating wire, and ϵ, determined by the frequency shift of a tunnel diode oscillator, can be measured simultaneously in both the ^{3}He-rich and the ^{4}He-rich phases below the separation. Data taken for 63.6 to 75.1% ^{3}He for temperatures between 0.45 and 1.2°K are presented. Viscosity and $\rho_n\eta$ results near the tricritical point and the resulting phase diagram for elevated pressures obtained from the measured dielectric constant are given. (MHR)

31261 CRITICAL OPALESCENT LIGHT SCATTERING IN ^{3}He–^{4}He MIXTURES NEAR THE TRICRITICAL POINT. Watts, D. R.; Webb, W. W. (Cornell Univ., Ithaca, NY). pp 581-585 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Mixtures of the two isotopes ^{3}He–^{4}He display a tricritical point at the junction of a lambda line of superfluid transitions and the consolute critical point, where a first-order miscibility gap goes continuously into perfect miscibility. This critical region was studied by carefully measuring the intensity of scattered light. Direct measurements of concentration changes due to gravity using a modified Jamin interferometer which measures the index of refraction of the mixture as a function of height are reported. The light scattering measurements of concentration susceptibility, which have been shown to be consistent with much of the data on C_p and P_{sat}, have produced highly unexpected critical exponents not adequately explained by present theories if these exponents are representative of the asymptotic critical region. Furthermore, all experiments that have been done on the ^{3}He–^{4}He mixture near the tricritical point which measure a property in the fluid very close to but not exactly on the interface will be dominated by gravitational effects within 5 to 10 m°K of T_c. (MHR)

31262 SECOND-SOUND VELOCITY, GRAVITATIONAL EFFECTS, RELAXATION TIMES, AND SUPERFLUID DENSITY NEAR THE TRICRITICAL POINT IN ^{3}He–^{4} He MIXTURES. Ahlers, G.; Greywall, D. S. (Bell Telephone Labs., Murray Hill, NJ). pp 586-590 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Results are reported for the second-sound velocity in liquid ^{3}He–^{4}He mixtures near the tricritical point which yielded information about the superfluid density, the coherence length, the

phase diagram, the effect of gravity, and concentration relaxation times. The measurements were made by determining the frequency of plane-wave resonant modes in a cylindrical cavity with a diameter of 0.6 cm and a height of 0.3 cm. The results for the velocity are shown as a function of temperature. (MHR)

31263 EXCITATION SPECTRUM OF ^{3}He–^{4}He MIXTURE AND ITS EFFECT ON RAMAN SCATTERING. Soda, T. (Tokyo Univ. of Education). pp 591-597 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

If one adds a dilute solution of ^{3}He to liquid ^{4}He and considers the energy spectrum of the mixture, then the original phonon–roton spectrum and the ^{3}He energy spectrum cross each other in the energy spectrum of the ^{3}He–^{4}He mixture if there is no interaction between ^{3}He and ^{4}He. The existence of the interaction between them presents the interesting problem of the two-level crossing. The addition of ^{3}He to liquid ^{4}He gives a shift in the roton-phonon spectrum, but it does not change the second branch of the original ^{3}He excitation spectrum. Calculations are made for a mixture system consisting of bosons and fermions. Phonon–roton spectra plots are shown. (MHR)

31264 LOW-TEMPERATURE SPECIFIC HEAT OF THE DILUTE SOLUTIONS OF ^{3}He IN SUPERFLUID ^{4}He. Brucker, H.; Disatnik, Y. (Tel-Aviv Univ., Israel). pp 598-601 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The low-temperature specific heat of the dilute superfluid solution of ^{3}He in ^{4}He was measured several years ago by Anderson et al. [Phys. Rev. Lett. 17, 367 (1966)]. Here, this data is reanalyzed with an improved expression based on the low-temperature equilibrium theory described in a recently published study [Disatnik and Brucker, J. Low Temp. Phys. 7, 491 (1972)]. (MHR)

31265 SPIN DIFFUSION OF DILUTE ^{3}He–^{4}He SOLUTIONS UNDER PRESSURE. Cheng, D. K. (State Univ. of New York, Stony Brook); Craig, P. P.; Kitchens, T. A. pp 602-607 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The transport properties of dilute solutions of ^{3}He in ^{4}He provide information about the effective interaction between the ^{3}He quasiparticles. Of the transport properties, the spin diffusion coefficient, which can be measured by NMR spin-echo techniques, is most sensitive to these interactions. Here, such measurements are reported on 4.97% and 1.15% ^{3}He in ^{4}He for pressures of 0.04, 9.2, and 20 atm at temperatures between 1.5 and 0.072 K. From the effective interaction potentials it appears that the temperature of the expected superfluid transition is highest for the lowest pressure and the smaller concentration studied. (MHR)

31266 SPIN DIFFUSION COEFFICIENT OF ^{3}He IN ^{3}He–^{4}He SOLUTIONS. Chang, D. C.; Rorschach, H. E. (Rice Univ., Houston, TX). pp 608-611 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Nearly all of the previous work on the diffusion of ^{3}He in superfluid ^{3}He–^{4}He solutions has been done on solutions whose molar ^{3}He concentration x was 5% or less. Measurements of the diffusion coefficient by the spin-echo method are reported here for solutions with x = 5%, 9%, 14%, and 24% for $0.9 < T < 2.5$ K. A simplified treatment of the diffusion process based on the Boltzmann equation and the Pomeranchuk model for the solution has been made. In this model the superfluid ^{3}He–^{4}He solution is assumed to consist of a mixture of a gas of ^{3}He atoms (fermions) and a gas of thermal excitations (bosons). It is shown that this description gives a good account of the diffusion process, except for the fermion–roton collisions near the solution lambda point, where the roton density is high and the dilute gas approximation breaks down. (MHR)

31267 NUCLEATION OF PHASE SEPARATION IN ^{3}He–^{4}He MIXTURES. Brubaker, N. R.; Moldover, M. R. (Univ. of Minnesota, Minneapolis). pp 612-617 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

Preliminary results are reported of experiments designed to study nucleation of phase separation in metastable thermodynamic states of liquid ^{3}He–^{4}He mixtures under a wide range of conditions. In addition to making some qualitative observations, it was possible to measure apparent lifetimes of metastable states in six solutions with mole fractions of ^{3}He in the range $0.22 \leq x \leq 0.611$. (MHR)

31268 RENORMALIZATION OF THE ^{4}He LAMBDA-TRANSITION IN ^{3}He–^{4}He MIXTURES. Gasparini, F. M. (Ohio State Univ., Columbus); Moldover, M. R. pp 618-622 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The specific heat at constant pressure at the λ-transition of pure ^{4}He is very nearly logarithmically divergent. In the presence of a constant ^{3}He concentration this specific heat is renormalized in such a way that it tends to reach a finite value with an infinite slope. It is pointed out that along with the renormalization of C_{px}, the specific heat at constant pressure, and ^{3}He concentration, one expects that $C_{p\phi}$, where $\phi \equiv \mu^3 - \mu^4$, the difference in the molar chemical potential of the two isotopes, will behave as C_p for pure ^{4}He. The data analyzed to obtain a more quantitative description for the behavior of C_{px} and $C_{p\phi}$. The data covers the concentration range from pure ^{4}He to x = 0.39, and extend in temperature to within ~5 μ°K of the transition. For all values of x they were taken with a partially filled calorimeter, i.e., along a path of liquid and vapor coexistence. This implies that the pressure, concentration, and amount of liquid sample would change as the temperature was changed. In order to verify that for the experimental conditions the measured heat capacity was C_{px} some new measurements were made at x = 0.30 both with a partially filled calorimeter and with a completely filled calorimeter. From these measurements as well as from additional independent estimates it was concluded that in the region $t < 10^{-2}$ the data is indeed C_{px} to within the accuracy of the measurements. (MHR)

31269 OSMOTIC PRESSURE OF VERY DILUTE ^{3}He–^{4}He MIXTURES. Landau, J.; Rosenbaum, R. L. (Israel Inst. of Tech., Haifa). pp 623-626 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The experimental results are presented from measurements of the osmotic pressure in the range of ^{3}He mole fraction X from 0.08 to 0.6% at the saturated vapor pressure. The osmotic pressure at constant X was measured as a function of temperature down to the lowest temperature of 20 m°K. The results confirm that the temperature dependence of the osmotic pressure is that of an almost ideal Fermi gas. (MHR)

31270 PRESSURE DEPENDENCE OF SUPERFLUID TRANSITION TEMPERATURE IN ^{3}He–^{4}He MIXTURES. Satoh, T.; Kakizaki, A. (Tohoku Univ., Sendai). pp 627-630 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The pressure dependence of the superfluid transition temperature in pure ^{4}He and mixtures of 3.85, 10.0 and 15.0% ^{3}He concentration is reported. The concentration of ^{3}He in mixtures was determined by measuring the pressure and assuming the ideal gas equation of state. Measurements were made from SVP to ~1 atm for each sample. The crystostat used is shown. (MHR)

31271 THERMAL DIFFUSION FACTOR OF ^{3}He–^{4}He MIXTURES: A TEST OF THE HELIUM INTERACTION POTENTIAL. Taylor, W. L. (Mound Lab., Miamisburg, OH). pp 631-635 of Low Temperature Physics: LT 13. Vol. 1. Timmerhaus, K. D. (ed.). New York; Plenum Publishing Corp. (1974).

From 13th international conference on low temperature physics; Boulder, Colorado, USA (21 Aug 1972). See CONF-720833-(P1).

The composition dependence of the thermal diffusion factor was measured at several low temperatures and the results were compared to several realistic helium intermolecular potentials. Because the isotopic separation is quite small, a trennschaukel or "swing separator" was used. In order to test the overall performance of the apparatus, the composition dependence was measured at 160°K. The measured composition dependence at the average temperature of 5½ and 30°K and the temperature dependence of an equimolar mixture are shown. (MHR)

31272 UNUSUAL MAGNETIC RELAXATION IN SUPERFLUID ^{3}He. Corruccini, L.R. (Physics Department, University

of California, Davis, Davis, California 95616); Osheroff, D.D. Phys. Rev. Lett. 34: No. 10, 564-567 (10 Mar 1975).

Pulsed-NMR measurements of the longitudinal spin-relaxation time T_1 in superfluid ^{3}He are reported which indicate that new and very unconventional relaxation mechanisms exist below T_c. In A-^{3}He, T_1 decreases very rapidly below T_c and the magnetization recovery from saturation is *linear* in time. In B-^{3}He, the magnetization recovery is exponential in time, but the relaxation rate $1/T_1$ is linear in applied field *gradient*. Possible explanations of these phenomena are discussed. (auth)

31273 NEW MODEL OF THE ANISOTROPIC PHASE OF SUPERFLUID He^3. Berezinskiĭ, V.L. JETP Lett. 20: No. 9, 287-289 (5 Nov 1974).

It is shown at a sufficiently large value of the exchange gain in He^3, there exists a possibility of pairing in states with spin s=1 with even orbital angular momenta. This does not contradict the Pauli principle, since the average many-time wave functions of the pairs (the anomalous Green's function) depends in odd manner on the difference between the temporal arguments. (auth)

31274 PROPERTIES OF A SELF-LOCALIZED CHARGED LAYER ON THE SURFACE OF LIQUID HELIUM. Chernikova, D. M. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 249-256(Jan 1975). (In Russian).

It is shown that interaction between electrons significantly affects the structure of a charged layer on the surface of liquid helium. Stability of the layer is also investigated. At low temperatures stability is violated in a discontinuous manner with increase of electron density at the surface. (auth)

31275 PHASE TRANSITIONS IN IDEAL BOSE GASES. Balagurov, B. Ya.; Vaks, V. G. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 136-143(Jan 1975). (In Russian).

Some singularities of the thermodynamics of an ideal Bose gas near the Bose condensation point T_0 in the presence of a generalized field H producing the condensate particles are considered. The dependence of the generalized moment (the square of which equals the number of particles in the condensate) on field strength H and temperature T near T_0 is quite peculiar and its shape is similar to that of the analogous equation of state in the two-dimensional Slater model with mobile impurities. The effect of randomly distributed fixed impurities on the transition is also investigated. The singularities of the thermodynamic quantities now become less pronounced and Bose condensation is possible in both the one- and two-dimensional cases. However, Bose condensation now corresponds to the localization of a macroscopically large number of particles in a microscopic region and hence allowance for finite compressibility apparently should appreciably alter the results and in particular lead to the disappearance of the transition in the one-dimensional case. (auth)

31276 THERMODYNAMIC PHENOMENA ON VORTEX FILAMENTS IN HELIUM. Shikin, V. B. (Inst. of Physics of Low Temperature, Kharkov). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2293-2306(Dec 1974). (In Russian).

It is shown that localization of thermal and impurity excitations on a vortex filament in helium leads to an experimentally observable dependence on the effective radius of the vortex filament core $b^*(c, T)$ on temperature and solute concentration. General formulas are derived which relate $b^*(c, T)$ with the value of the thermodynamic potential per unit length filament for excitations localized on the filament $\alpha(c, T)$. Calculations of $\alpha(c, T)$ for a vortex filament in pure ^{4}He and for a vortex in a weak ^{3}He-^{4}He solution are presented for extremely low temperatures. In the first case the explicit form of the dispersion law for bending vibrations of the vortex filament is employed in the calculations. In the second case a phenomenological calculation of $\alpha(c, T)$ is found to be possible (with an accuracy to two constants) which is independent of details of the spectrum of impurity excitations localized on the filament. The results of the theory for weak solutions are compared with available experimental data. Qualitative agreement between theory and experiment is noted. The problem of motion of vortex-rings along the vapor-liquid interface in liquid helium is formulated in the appendix and solved for some limiting cases. It is shown that the proximity of the boundary leads to a number of observable effects. It is suggested, in particular, that under certain conditions the formation of vortex semi-rings should be possible, their ends reaching the free surface of helium. (auth)

31277 EVEN MECHANISM OF THE SUPERFLUIDITY IN BOSE-SYSTEMS. Kondratenko, P. S. Teor. Mat. Fiz.; 22: No. 2, 278-287(Feb 1975). (In Russian).

Microscopic theory of interacting bose-systems with ground state consisting of the condensate of bound particle pairs is proposed. It is shown that low-frequency excitations and their interactions in such systems are the same as in the bose-liquids with single-particle condensate. Distinctions between the properties of the two types of systems consist in conditions of vortex quantization and in possibility of high-frequency single-particle excitations. (auth)

31278 ELECTRONS AND VORTEX LINES IN He II. I. Brownian Motion Theory of Capture and Escape. McCauley, J.; Onsager, L. (Yale Univ., New Haven). J. Phys., A (London); 8: No. 2, 203-213(Feb 1975).

The Brownian motion theory of capture and escape, in the form given by Onsager (J. Chem. Phys.; 2: 599(1934)), is applied to the interaction of electrons and vortex lines in He II. Precise results are obtained to lowest order in the external field strength and certain misconceptions are clarified, laying the foundation for a reliable analysis of the available experimental data. (auth)

31279 DENSITIES OF THE SUPERFLUID COMPONENT IN ^{3}He-^{4}He MIXTURES. Tominaga, A.; Kobayashi, T.; Uehara, F.; Narahara, Y. (Tokyo Univ. of Education). J. Phys., C (London); 8: No. 4, 420-424(21 Feb 1975).

Data from two types of experiments, namely oscillating discs and second sound, have been analyzed. It was found that the temperature dependence of the superfluid density in the ^{3}He-^{4}He mixtures is the same as that in pure ^{4}He and that its concentration dependence can be expressed by an empirical equation: $\rho_s(X, T^*) = \phi^2\rho_s^0(T^*)$ where T^* is the dimensionless temperature $T/T_\lambda(X)$ and ϕ is the volume fraction of the ^{4}He component in the superfluid ^{3}He-^{4}He mixtures. The molar concentration of the ^{3}He component is denoted by X. At very low temperatures and in the dilute limit this equation gives as the value of the hydrodynamic effective mass of ^{3}He $M_3^* = 2.7\ M_3$. (auth)

31280 SPATIAL DECAY OF TEMPERATURE NONUNIFORMITIES: THE WEAKLY INTERACTING BOSE GAS. Saslow, W. M. (Texas A and M Univ., College Station). Phys. Rev., A; 10: No. 6, 2482-2487(Dec 1974).

The spatial decay of temperature nonuniformities in the weakly interacting Bose gas is studied by utilizing Ma's low-temperature solutions of the Boltzmann equation. These results, which give exponential decay lengths varying as T^{-9}, may be relevant to He II for $T \lesssim 0.1$°K. The longest two decay lengths, δ_1 and δ_2, are found to be in nearly a ten-to-one ratio, with $\delta_1 \approx 3.41 \times 10^3$ cm for He II at 0.1°K. At higher temperatures the decay lengths are expected to decrease less rapidly than T^{-3} because of phase-space considerations, but an extrapolation to 0.3°K does indicate δ_1 to be on the order of 1 cm. Two types of experiments are suggested for determining these lengths. It is pointed out that information about phonon dispersion can be obtained from such measurements. (auth)

31281 COLLECTIVE SPIN-ORBIT WAVES IN THE B PHASE OF ^{3}He. Brinkman, W. F.; Smith, H. (Univ. of Copenhagen). Phys. Rev., A; 10: No. 6, 2325-2329(Dec 1974).

The collective modes associated with oscillations of the order parameter in the B phase are calculated. The phase is assumed to be the Balian-Werthamer state, and it is shown that there are three collective modes in which both the orbital and spin angular momenta of the Cooper pairs oscillate. The two modes with transverse polarization are found to have a velocity $\sqrt{2}$ times as large as the longitudinal mode. In the presence of the dipole interaction these modes are mixed, with one mode becoming the longitudinal resonance in zero field. (auth)

Superconductivity

Refer also to abstracts 29503, 29505, 29509, 29510, 30102, 30141, 30193, 30229, 30230, 30249, 30250, 30260, 30261, 30264, 30285, 30323, and 31166.

31282 (LA-tr-74-36) MEASUREMENT OF SUPERCONDUCTION PROPERTIES (ALTERNATE CURRENT LOSS, MAGNETIZATION, SURFACE PHENOMENA) BY LOCK-IN-AMP. Noda, M. 1974. Translation of Research Papers No. 5, Reprint. 21p. Dep. NTIS $4.25.

The Lock-in-amp technique was used for the clarification of various superconducting properties, and methods for their measurement were established. A discussion is presented on their features from the measured results, and any remaining problematical points are summarized. (MHR)

31283 THERMOELECTRIC EFFECT IN ANISOTROPIC SUPERCONDUCTORS. Ginzburg, V.L.; Zharkov, G.F. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 20: No. 10, 302-304 (20 Nov 1974).

We discuss the thermoelectric effect that is produced in a homogeneous anisotropic superconductor in the presence of a temperature gradient. (auth)

31284 FLUCTUATION PHENOMENA IN SUPERCONDUCTORS IN THE PRESENCE OF A STRONG CONSTANT MAGNETIC FIELD. Golub, A.A.; Chernobai, V.A. (Institute of Applied Physics, Academy of Sciences of the Moldavian SSR, Kishinev). Sov. Phys.—Solid State 16: No. 8, 1540-1543 (Feb 1975).

The contribution of fluctuation pairing of electrons above the superconducting transition temperature to the nuclear spin relaxation rate is calculated for pure superconductors in constant magnetic field $H \gtrsim H_{c_2}(0)$ [$H_{c_2}(0)$ is the upper critical field]. A detailed study is made for the thin-film case, which, possibly, is valid as a description of layered superconducting structures. In the region of strong fields the fluctuation contribution to the heat capacity of "dirty" superconductors is also calculated. In contrast to the weak-field limit, the heat capacity is proportional to $\sqrt{H}$ in bulk samples. The region of application of the mean-field approximation used for the calculation of the heat capacity is investigated. (auth)

31285 PROPERTIES OF SUPERCONDUCTORS WITH STRONG COUPLING CLOSE TO THEIR CRITICAL TEMPERATURE IN ARBITRARY MAGNETIC FIELDS. Masharov, N.F. (Scientific-Research Institute of Physicotechnical and Radio-Engineering Measurements, Mendeleevo, Moscow Province). Sov. Phys.—Solid State 16: No. 8, 1524-1527 (Feb 1975).

The Ginzburg-Landau equations are obtained from the microscopic theory of superconductivity in which the electron-phonon interaction is taken into account explicitly. General expressions are obtained for the experimentally observable quantities characterizing the properties of superconductors and their alloys. A comparison with experimental results indicates that the strong-coupling theory provides a better description of superconductors than the weak-coupling model. (auth)

31286 THERMOELECTRIC PHENOMENA IN THE INTERMEDIATE STATE OF SUPERCONDUCTORS. Dzhikaev, Yu. K. (Inst. of Problems in Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 295-307(Jan 1975). (In Russian).

The thermoelectric coefficient tensor α_{ij} in pure metals with an excitation mean free path $l \gg a$ (a is a characteristic layer dimension) is calculated for the intermediate state of superconductors of the first kind. The diagonal component α_{ij} which is responsible for the electric current along the layers and across the magnetic field is 1.5 times greater than the same coefficient in an impure metal. The component which is transverse with respect to the layers is determined by the angular dependence of the probability for traversal of the n–s boundary by excitations, w, and may be either positive or negative depending on the metal properties and orientation of the n–s boundary. It is shown that in the presence of heat flow the structure of the intermediate state tends to rotate at low temperatures in such a way that the heat flows along the layers in accordance with the observations. It is also demonstrated that besides excitations which are reflected from the boundary by the Andreyev's mechanism, there is a small group of excitations sliding along the boundary in an angle $(T/\mu)^{1/2}$ (μ is the chemical potential) which undergo specular reflection. (auth)

31287 NONZERO SPIN PAIRING IN LAYER SUPERCONDUCTORS AND IN QUASI-ONE-DIMENSIONAL SUPERCONDUCTORS. Efetov, K. B.; Larkin, A. I. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 155-163(Jan 1975). (In Russian).

Layer and quasi-one-dimensional superconductors are considered in which attraction between electrons located in neighboring layers or filaments is the strongest. Superposition of states with spin 0 or spin 1 occurs in such superconductors. The effect of a magnetic field and electron transitions on the properties of the superconductors is investigated. The results are compared with the experimental results. (auth)

31288 PINNING OF A VORTEX LATTICE AT THE INTERFACE OF TWO SUPERCONDUCTORS AND THE CRITICAL CURRENT. Mkrtchyan, G. S.; Shmidt, V. V. Zh. Eksp. Teor. Fiz.; 68: No. 1, 186-195(Jan 1975). (In Russian).

The problem of calculating the interaction energy between a vortex lattice and interface between two superconductors is solved. The vortex lattice is assumed to be parallel to the plane of the interface. The superconductors differ with respect to depth of penetration of magnetic field and to coherency length. The interaction between the vortexes and interface makes possible the passage of a transport current perpendicular to the vortexes along the interface. The current flows in a band of thickness $\sim\lambda_1 + \lambda_2$ near the boundary (λ is the penetration depth). Estimates show that the critical current is a monotonously decreasing function of the magnetic field. The critical current density may reach $\sim 10^5$ A/cm^2 if the difference in λ is only 1%. (auth)

31289 MICROSCOPIC THEORY OF RESISTIVE CURRENT STATES IN SUPERCONDUCTING CHANNELS. Galaiko, V. P. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 68: No. 1, 223-237(Jan 1975). (In Russian).

Some features of the linear response to a longitudinal electric field are analyzed for electrons in a metal; the role which the electric neutrality condition plays in this case is also considered. In contrast to normal metals, for which the condition expresses continuity of current, in superconductors, due to electron pair "annihilation" and "production" from the superconducting condensate, the electric neutrality condition is an independent equation which determines the distribution of the electric potential. As in the equilibrium case the equation of continuity of the total (normal plus superconducting) current is contained in the equation for the phase of the complex superconducting ordering parameter. Kinetic equations are set up for an "impure" superconductor and a solution of the equations is found which satisfies the requirements mentioned above. The structure of the resistive current state in the superconducting channel which is a microscopic phase stratification with alternating superconducting and normal regions along the channel is investigated by means of the equations. (auth)

31290 ABSORPTION OF TRANSVERSE SOUND IN SUPERCONDUCTORS. Gal'perin, Yu. M. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2195-2203 (Dec 1974). (In Russian).

The temperature and frequency dependences of transverse ultrasound absorption in superconductors are investigated. Two mechanisms are responsible for absorption of transverse sound: Joule losses connected with the presence of varying electromagnetic fields and a mechanism involving incomplete dragging of electrons by the moving lattice. It is demonstrated that for temperatures near the transition point the electromagnetic contribution may be dominant. Dispersion of the current response function in a superconductor can be directly assessed by studying the electromagnetic contribution to absorption of transverse sound. (auth)

31291 VISCOUS RESISTANCE OF VORTEXES IN SUPERCONDUCTORS OF THE SECOND KIND. Goncharov, I. N.; Dorofeyev, G. L.; Nichitiu, A.; Petrova, L. V.; Frichevskii, G.; Khukhareva, I. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2235-2245(Dec 1974). (In Russian).

The flux-flow resistance $\rho_f(H, T)$ in recrystallized strips of the superconducting alloy Nb–80% Zr is measured from 1 K up to T_c and throughout the whole magnetic field range. The temperature dependence of the coefficient of viscosity for moving vortexes is derived from the measurement and compared with the microscopic theory. The behavior of $\rho_f(H)$ for all magnetic field values is compared with the theory for $T \to T_c$. To explain the dependence of the depth and position of the minimum on the $\rho_f(T)$ curve on magnetic field strength, the thermal viscosity coefficient for a system of independent vortexes is calculated and compared with the experimental results. (auth)

31292 EFFECT OF SPIN FLUCTUATIONS ON THE SUPERCONDUCTING AND NORMAL PROPERTIES OF ALLOYS OF Ti CONTAINING V, Nb, OR Ta. Prekul, A. F.; Rassokhin, V. A.; Volkenshtein, N. V. (Inst. of Metal Physics, Sverdlovsk, USSR). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2286-2292(Dec 1974). (In Russian).

The temperature dependences of the electric resistance in Ti–Nb and Ti–Ta alloys are studied in a broad range of concentrations and temperature. A comparative analysis of previous data for Ti–V alloys is carried out with the aim of ascertaining the causes and conditions of appearance of scattering involving spin flip. It is shown that in the direction from V to Ta the anomalous properties due to a negative resistance temperature coefficient and broad transitions to the superconducting state are weakened. This indicates the decisive role played by the d-band width in these effects and that the general assumptions of the Rivier–Zlatič model regarding incomplete collectivation of d-electrons as a necessary condition for the appearance of spin inhomogeneities are correct. Lattice deformation may be the initiator of the electron spectrum with a narrow band of virtual states near the Fermi level. It is pointed out that the magnetic contribution to the specific heat may be considerable at low temperatures and result in deviations from the shape predicted by the microscopic theory of superconductivity. (auth)

31293 EFFECT OF PARAMAGNETIC IMPURITIES ON RELAXATION OF NUCLEAR SPINS IN THE SUPERCONDUCTORS. Moskalenko, V. A.; Vladimir, M. I. (Institute of Applied Physics, The Moldavian Academy of Sciences, USSR). Phys. Lett., A; 50: No. 5, 353-354(30 Dec 1974).

The ratio of nuclear spin relaxations rates R_s/R_n in the superconductors is calculated for different temperatures and concentrations of paramagnetic impurities, on the basis of exact formulae for the density of electronic states and the factor of coherence. (auth)

31294 PARACONDUCTIVITY OF SUPERCONDUCTORS IN MAGNETIC FIELDS. Feat, G. R.; Rickayzen, G. (Univ. of Kent, Canterbury, Eng.). J. Phys., F (London); 5: No. 2, 307-323(Feb 1975).

The effect of a uniform magnetic field on the paraconductivity of a thin film of a superconductor is calculated for conditions outside the classical region. It is assumed that the fluctuations in the order parameter can be described by the Ginzburg-Landau functional; the fourth order term is treated in the Hartree approximation below the transition temperature T_c, and by the "Hartree-Fock" approximation above T_c. Fields both parallel and perpendicular to the film are considered. For fields perpendicular to the film and temperatures below T_c only conditions without flux flow are considered. A preliminary comparison of the theory with experiment shows that although the appropriate regions of field and temperature are accessible to experiment, experiments which can test the theory have yet to be performed. (auth)

31295 DOUBLING OF THE PERIOD OF FLUX QUANTIZATION IN HOLLOW SUPERCONDUCTING CYLINDERS DUE TO QUANTUM EFFECTS IN THE NORMAL STATE. Bogachek, E. N.; Gogadze, G. A.; Kulik, I. O. (Physical-Technical Inst. of Low Temperatures, Kharkov). Phys. Status Solidi (b); 67: No. 1, 287-291(1 Jan 1975).

The effect of quantization of normal excitations in thin-walled hollow superconducting cylinders on the critical temperature versus magnetic flux oscillations is considered. It is shown that the period of oscillations is hc/e instead of hc/2e, as in the Parks-Little effect. The phenomenon is connected with the so-called Aharonov-Bohm effect and disappears if the quantum levels are smeared out, particularly due to volume or surface scattering or finite temperature. (auth)

31296 CALCULATION OF THE SPECIFIC HEATS OF SUPERCONDUCTORS WITH A QUASIPARTICLE APPROXIMATION. Nowotny, H.; Grau, D.; Hittmair, O. (Technische Hochschule, Vienna). Acta Phys. Austr.; 38: No. 4, 354-360(1973). (In German).

An approximate expression for the electron Green function of superconductors was used for a quasi particle description and the specific heat of this quasiparticle gas was calculated. It was shown that the experimental deviations from the BCS pattern were expressed well. A detailed comparison was given for experimental data on Nb. (tr-auth)

31297 ENERGY SPECTRUM OF SUPERCONDUCTORS WITH DEFECTS POSSESSING SPHERICAL AND CYLINDRICAL SYMMETRY OF THE POTENTIAL OF INTERACTION WITH CONDUCTIVITY ELECTRONS. Gvozdikov, V. M.; Fal'ko, I. I. (Kharkov State Univ.). Teor. Mat. Fiz.; 22: No. 2, 269-277(Feb 1975). (In Russian).

Spatial behavior of the ordering parameter in superconductors with defects is considered. Two cases are investigated; a) the point defect, for which the potential of interaction with conductivity electrons is rotationally invariant; b) the linear defect, for which the potential of interaction with conductivity electrons is invariant under the rotations with respect to the defect axis. (auth)

31298 SUPERCONDUCTIVITY AND THE STABILITY OF THE CRYSTAL LATTICE. Kodess, B. N. (Kirov Polytechnic Inst., USSR). Solid State Commun.; 16: No. 3, 269-273(1 Feb 1975). (In French).

Data are presented for the concentration dependences of the critical temperatures T_c and T_m and for the magnetic susceptibility of A15 compounds in the Nb-Ge-Al system. An anomalous decrease in the intensity of the Bragg reflections as well as in the diffuse background has been found with a reduction in temperature. The magnetic properties of superconducting compounds having high values of T_c are discussed. (auth)

31299 SUPERCONDUCTIVITY: PHENOMENA, THEORY, MATERIALS. Cody, G. D.; Webb, G. W. (RCA/David Sarnoff Research Center, Princeton, NJ). CRC Crit. Rev. Solid State Sci.; 4: No. 1, 27-84(Dec 1973).

The following subjects are discussed: Bardeen-Cooper-Schrieffer (BCS) theory; Type-II superconductivity; critical currents of superconductors; thin film superconductors; superconductive tunneling; fluctuation phenomena; high frequency behavior of superconductors; representative materials: transition metals: elements, alloys, and compounds; superconducting semiconductors; granular superconductors; and intercalated layer compunds; and materials for technology: $Nb_3(AlGe)$ and other Nb_3 Al-based ternary materials; Nb_3Ga, Nb_3Al, and Nb_3Ge; NbN, NbC, $NbN_{1-x}C_x$, and $Nb_{1-x}Ti_xN$; and Nb_3Sn and Nb_3Sn-based ternaries. (MHR)

31300 PROPERTIES OF TYPE-II SUPERCONDUCTORS WITH ARBITRARY IMPURITY CONCENTRATION NEAR H_{c2}. Ovchinnikov, Yu. N. (Inst. of Theoretical Physics, Moscow); Brandt, E. H. Phys. Status Solidi (b); 67: No. 1, 301-315(1 Jan 1975).

The magnetic field distribution H and the magnetization $4\pi M$ are calculated by the method of energy-integrated Green's functions near the upper critical field H_{c2} as a function of temperature, electron mean free path, and of the concentration of paramagnetic impurities. The field distribution of Delrieu and of one of the authors is thereby reproduced. The non-linearity of the magnetization curve is investigated. At low temperatures and long mean free paths this non-linearity becomes pronounced and leads to a logarithmically vanishing slope of the magnetization curve as the applied field approaches H_{c2}. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 31405, 31553, 31630, and 31633.

31301 (BNL-19411) PROTON CHEMICAL BINDING IN WATER AND ITS EFFECT ON NEUTRON ABSORPTION IN THE 1 eV RESONANCE OF ^{240}Pu. Buslik, A. J. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1974. 32p. (RP-1035). Dep. NTIS $4.75.

Proton chemical binding in water and its effect on neutron absorption in the 1 eV resonance of ^{240}Pu are discussed. Various methods of including these effects are presented, and a method is chosen on the basis of a numerical comparison to a calculation using the Haywood scattering kernel for hydrogen; this calculation serves as a standard. The numerical results presented show that the use of the approximate hydrogen scattering kernel suggested by Cady, Kirouac, and McInerney is sufficiently accurate for the calculation of the resonance absorption in the ^{240}Pu 1 eV resonance. (1 figure, 1 table) (RWR)

31302 (BNL-19543) INCORPORATION OF EPITHERMAL PROTON CHEMICAL BINDING EFFECTS IN HAMMER. Buslik, A.; Herczeg, J. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1974. 36p. (RP-1036). Dep. NTIS $5.00.

Those changes to the hydrogen epithermal library in HAMMER, and those changes to the HAMMER program itself, which are required to incorporate the effects of the chemical binding and thermal motion of the protons in water on the epithermal neutron flux and reaction rates are reported. The changes to the hydrogen epithermal library required are changes to the slowing-down power, $\xi\sigma_s$; the Greuling–Goertzel parameter, γ; and the P-1 component of the scattering cross-section, σ_{s1}. The changes to the HAMMER program which are required consist of changes to the program to ensure that the slowing-down power, $\xi\sigma_s$, and the Greuling–Goertzel parameter, γ, for hydrogen are used in all of the subroutines. In addition, changes are required to modify the Dancoff factor used in the ^{240}Pu 1 eV resonance treatment and the cosine current calculation of the lattice escape probabilities used in the resonance absorption calculation. (3 figures, 1 table) (RWR)

31303 (CEA-N-1761) L. ENDF PROGRAM. Beauge, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Services des Piles). Oct 1974. 59p. (In French). Dep. NTIS (US Sales Only) $6.00.

A FORTRAN program is described for reading ENDF III tape coming from the N.D.C.C. and for producing data to be entered into the SOURCE I program. Various aspects of nuclear science are given as applications. (PMA)

31304 (CINDA-74(Vol. 1)) INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. Volume 1. $Z \leq 53$. (International Atomic Energy Agency, Vienna (Austria)). 17 Mar 1974. 972p. IAEA.

CINDA, the Computer Index of Neutron Data, contains bibliographical references to measurements, calculations, reviews, and evaluations of neutron cross sections and other microscopic neutron data; it includes also index references to computer libraries or numerical neutron data exchanged between the four regional neutron data centers. CINDA 74 is a cumulative issue in two volumes, and supersedes all earlier issues. It contains the complete CINDA file as of 17 March 1974. This volume contains nuclides with $Z \leq 53$. (RWR)

31305 (CINDA-74(Vol. 2)) INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. Volume 2. $Z \geq 54$. (International Atomic Energy Agency, Vienna (Austria)). 17 Mar 1974. 989p. IAEA.

CINDA 74 is a cumulative issue which contains the complete CINDA file as of 17 March 1974 and supersedes all earlier issues. This volume contains nuclides with $Z \geq 54$, as well as several appendixes. (RWR)

31306 (CINDA-74(Supp.)) INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. Supplement. (International Atomic Energy Agency, Vienna (Austria)). 1 Oct 1974. 265p. IAEA.

CINDA, the Computer Index of Neutron Data, contains bibliographical references to measurements, calculations, reviews, and evaluations of neutron cross sections and other microscopic neutron data; it also includes index references to computer libraries of numerical neutron data exchanged between the four regional neutron data centers. This volume is a supplement to CINDA 74, and both issues together contain the full CINDA file as of 1 October 1974. (RWR)

31307 (CONF-750303-30) UNCERTAINTIES AND CORRELATIONS IN EVALUATED DATA SETS INDUCED BY USE OF STANDARD CROSS SECTIONS. Peelle, R. W. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A file of cross-section uncertainty information for use in reactor performance uncertainty analysis should take into account the propagated effects of uncertainties in the standard cross sections used. This problem was analyzed by using first-order error theory in terms of the uncertainties in the standard cross sections and the energy-dependent weight given to each underlying experimental result in obtaining an evaluated cross section. Three cases occur depending on whether the energy dependence of the standard was utilized, and, if so, whether the absolute magnitude or only the shape of the standard cross section was used in an underlying experiment. The analysis yields the uncertainties in and correlations among the evaluated cross sections. The resulting uncertainty files need not refer explicitly to the uncertainties in standards and can use the same set of formats employed for other uncertainty data. (auth)

31308 (CONF-750303-31) ESTIMATED UNCERTAINTIES IN NUCLEAR DATA: AN APPROACH. Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 6p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The need to communicate estimated uncertainties in evaluated nuclear data to be used in the assessment of their adequacy in applications has been recognized in the ENDF/B system. Starting with ENDF/B-IV, the data files contain formatted data describing the estimated covariances of some of the microscopic cross sections in such a form that they can be processed by computer codes to generate covariance matrices of quantities used in solving neutron transport problems such as group cross sections. The basic concepts behind the representation of such quantities are described, and the work done so far in the representation and manipulation of such quantities is discussed. Problem areas not yet addressed in ENDF/B-IV but under study are discussed. (auth)

31309 (CONF-750303-34) CROSS SECTION PREPARATION FOR THE CONTINUOUS-ENERGY MONTE CARLO CODE VIM. Prael, R. E. (Argonne National Lab., Ill. (USA)). Mar 1975. 6p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Improvements in the methods used to represent cross sections in the data library for the Monte Carlo code VIM are discussed. The degree to which observed difficulties were eliminated and the reliability of the current VIM library based on ENDF/B Version 3 data are illustrated by comparison of broad-group cross section calculations made by VIM and by $ET\phi E\text{-}2/MC^2\text{-}2$. (4 tables) (auth)

31310 (FOA-C-20017-A2) COLLISION PROBABILITY METHOD FOR TIME-DEPENDENT NEUTRON TRANSPORT. Lefvert, T. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1974. 39p. Dep. NTIS (US Sales Only) $5.00.

An approximate method for the solution of the pulsed neutron problem is described. Using mean collision times, defined through collision probability weighting, the time variation of successively collided fluxes in a pulsed system is developed and added into a total flux. The method is tested against both time-dependent S_n and Monte Carlo calculations and also used to analyze a fast neutron pulsed experiment. (auth)

31311 (IAE-2350) NEUTRON TRANSPORT IN MEDIA WITH CHANGING PARAMETERS. II. Classifications of the Conditions for Existence of the Classical Solutions. Novikov, V. M.; Shikhov, S. B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The neutron transport equation with any finite number of delayed neutron groups is considered under conditions of arbitrary physically permissible changes of medium parameters. The types of changes of the medium parameters under which the classical (i.e. time-differentiable) solutions exist in L_p spaces are pointed out and classified. The classical solutions belong to some classes of

functions which are exactly defined. The completeness of these classes in L_p spaces is proved. (4 figures, 1 table) (auth)

31312 (INT-32/I) GENERALIZATION OF THE MULTIGROUP APPROACH FOR CALCULATING THE NEUTRON SLOWING DOWN LENGTH. Kreft, A. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). Nov 1972. 50p. INIS.

An original method for calculating the neutron slowing down length, using a generalized multigroup approach, is presented. Unlike other multigroup methods, this method takes into account all the basic phenomena involved in the neutron transport, viz. the elastic scattering, the inelastic scattering and the neutron absorption. The procedure for calculating L_s for a polyenergetic neutron source is given together with its theoretical substantiation. The procedure applies for soils and rocks of any chemical composition and for all neutron sources whose energies do not exceed 10.5 MeV. The FORTRAN programs for computations are included. Results of calculations—the media being water-saturated sandstone and limestone of different porosity (from 0% up to 100%)—are presented for monoenergetic neutrons and for radioisotope Ra–Be neutron sources. A good agreement between the calculated L_s values and available experimental values of other authors can be observed, both for water and for weakly slowing down media, viz. dry sandstone and dry limestone. For the media containing relatively small amounts of hydrogen a nonmonotonic dependence of the slowing down length on the neutron initial energy has been observed. (auth)

31313 (JAERI-M-5769) SPLINT: A COMPUTER CODE FOR SUPERIMPOSED PLOTTING OF THE EXPERIMENTAL AND THE EVALUATED DATA. Narita, T.; Nakagawa, T.; Kanemori, Y.; Yamakoshi, H. (Japan Atomic Energy Research Inst., Tokai). Jul 1974. 24p. (In Japanese). Dep. NTIS (US Sales Only).

To facilitate the review and the evaluation work on nuclear data, a computer code has been prepared for plotting the experimental and the evaluated data superimposed in the same coordinates. For cross sections or angular distributions, many different sets of the experimental data in NESTOR format and the evaluated data in ENDF/B, UKNDL and KEDAK formats can be superimposed by the code. This work has been performed as a part of the project of the sub-working-group on storage and retrieval systems for nuclear data in the Japanese Nuclear Data Committee. Users of the code should be discreet in handling the preliminary or unpublished data. (auth)

31314 (JINR-P3-8470) GAS AND FROZEN CONVERTERS AS THE SOURCES OF ULTRACOLD NEUTRONS. Akhmetov, E. Z.; Golikov, V. V.; Kaipov, D. K.; Konks, V. A.; Strelkov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 30p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The technique and the results of calculations of yields of ultracold neutrons (UCN) from some gas and frozen converters are presented. The experimentally obtained UCN yields from hydrogen, deuterium, helium, and air at different temperatures and from a number of frozen materials (water, heavy water, alcohols) at room temperature don't differ practically from that of water, while the UCN yield from frozen water exceeds by about 25 times the yield from aluminum. (5 figures, 8 tables) (auth)

31315 (LA-UR-75-185) DISCRETE ORDINATE-TO-SPHERICAL HARMONIC CONVERSIONS FOR RAY EFFECT MITIGATION IN X-Y GEOMETRY. Miller, W. F. Jr.; Reed, W. H. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 30p. (CONF-750406-4). Dep. NTIS $4.50.

From ANS topical meeting on computational methods in nuclear engineering; Charleston, South Carolina, USA (15 Apr 1975).

Several fictitious sources are considered that, when appended to the discrete ordinates equations, convert those equations to spherical harmonic or spherical harmonic-like equations. The fictitious sources reported in the literature are cataloged by using projection operator notation. A new source that yields better computer running times for spherical harmonics solutions is presented. The S_2 to P_1 source is discussed in detail, including vacuum and reflective boundary conditions. A simple algorithm for reducing the running times required to obtain spherical harmonic solutions is presented. This algorithm reduces the size of the fictitious source in groups where ray effect distortions are not expected. The new source and the algorithm for running time reduction make this approach viable for solving the ray effect problem. (4 figures, 2 tables) (auth)

31316 (LA-UR-75-317) NUCLEAR MODELS AND DATA FOR GAMMA-RAY PRODUCTION. Young, P. G. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 8p. (CONF-750303-47). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The current Evaluated Nuclear Data File (ENDF/B, Version IV) contains information on prompt gamma-ray production from neutron-induced reactions for some 38 nuclides. In addition, there is a mass of fission product yield, capture, and radioactive decay data from which certain time-dependent gamma-ray results can be calculated. These data are needed in such applications as gamma-ray heating calculations for reactors, estimates of radiation levels near nuclear facilities and weapons, shielding design calculations, and materials damage estimates. The prompt results are comprised of production cross sections, multiplicities, angular distributions, and energy spectra for secondary gamma-rays from a variety of reactions up to an incident neutron energy of 20 MeV. These data are based in many instances on experimental measurements, but nuclear model calculations, generally of a statistical nature, are also frequently used to smooth data, to interpolate between measurements, and to calculate data in unmeasured regions. The techniques and data used in determining the ENDF/B evaluations are reviewed, and comparisons of model-code calculations and ENDF data with recent experimental results are given. (11 figures) (auth)

31317 (UCID-16682) DOES MORSE-L REALLY WORK? Wilcox, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Sep 1972. Contract W-7405-eng-48. 49p. Dep. NTIS $5.50.

The MORSE-L code is too large ever to be checked in its entirety; however, options commonly used can be checked. This report to the user describes work which has been done to insure the proper operation of MORSE-L. Twelve "benchmark" problems are discussed. (18 figures, 9 tables) (RWR)

31318 (UCID-16683) MORSE CROSS SECTION LIBRARY TAPES. Wilcox, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jul 1973. Contract W-7405-eng-48. 67p. Dep. NTIS $6.50.

The topic of MORSE cross section library tapes is thoroughly discussed. These tapes may be used with the MORSE-L, MORSE-C, or ANISN-L computer codes; other codes can also be written or modified to use these tapes. A number of cross section libraries exist in the MORSE tape format; these are explained and described in detail. Newly updated versions of the L-Division neutron and coupled neutron–gamma libraries are utilized. Not just one library is to be used with the above three codes; care must be taken to insure that the group structure provides sufficient cross section energy detail where detail is needed and that the proper weighting spectrum is used. (3 figures, 17 tables) (RWR)

31319 (UCID-16727) LAWRENCE LIVERMORE LABORATORY EVALUATED NUCLEAR DATA LIBRARY (ENDL) TRANSLATED INTO THE ENDF/B FORMAT. Howerton, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1975. Contract W-7405-Eng-48. 13p. Dep. NTIS $4.00.

The LLL Evaluated Nuclear Data Library (ENDL) of February 15, 1975 was translated into the ENDF/B Format. This translation is for the convenience of those persons who wish to use the ENDL data, but whose main familiarity is with the ENDF/B formats and procedures. Only the portion of ENDL which deals with neutron-induced interactions (including photon production from neutron-induced reactions) was translated. (1 table) (auth)

31320 (WANL-TME-696) IMPROVED METHOD FOR COMPUTATION OF EPITHERMAL GROUP CROSS SECTIONS. Stevens, C. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Mar 1964. 28p. Dep. NTIS $4.50.

Reasons for using the code GAM-I to generate fast group constants are set forth. The version received, however, had not been debugged. Corrections and improvements made are briefly described, and then the instruction for the revised GAM-I program are given. Appendixes give the material numbers for each nuclide on the library tape and instructions for using the combined GAM–TNS II program, which can generate multigroup fast and thermal cross sections. (RWR)

31321 (WANL-TME-1214) TRANSPORT THEORY STATUS REPORT. DeBaryshe, P. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1965. 28p. Dep. NTIS $4.50.

This status report is divided into two parts. The first part deals with certain problems arising in the choice of quadrature coefficients in the discrete S_n approximation to the linear transport equation. A new set of such coefficients is advocated for use with the S4 approximation. The second part describes the programing effort in S_n-type transport codes. (auth)

31322 (WANL-TME-1908) THE MOHYX PROGRAM: NEUTRON SCATTERING IN MOLECULAR HYDROGEN. Gibson, G.;

Collier, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1969. 186p. Dep. NTIS $12.50.

In order to carry out calculations for a reactor used in a nuclear rocket, it is desirable to have a detailed calculation of the neutron–hydrogen scattering cross section with spin correlations and the internal degrees of freedom of the H_2 molecule taken into account. The computer program MOHYX, based on the equations of Young and Koppel [Phys. Rev.; 135: A603(1964)], was developed for computing effective double-differential scattering cross sections, the P(0) and P(1) transfer matrices, and the scattering cross section and mean scattering angle for a neutron scattering in hydrogen gas; the gas may be at any temperature below 2000°K. Neutron energies may be 1 eV or less. MOHYX was programmed in FORTRAN IV and assembly language for the CDC 6600. A plot of the scattering cross section per atom of para- and ortho-hydrogen as a function of initial neutron energy is shown. The changes in the scattering cross sections as the temperature of the scattering gas changes are demonstrated. A plot of the average cross section per atom of hydrogen gas in equilibrium at 300°K is given. The computer time required to generate the four transfer kernels, para P(0) and P(1) and ortho P(0) and P(1), at T = 20.4°K was 38 minutes. (35 figures, 6 tables) (RWR)

31323 (WARD-XS-3045-8) PHYSICS EVALUATIONS AND APPLICATIONS. Progress Report for Period Ending January 31, 1975. Bortz, A. B.; Paik, N. C.; Davis, W.; Yarbrough, M. B.; Petras, D.; Lancaster, D.; Arakali, V. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Feb. 1975. Contract AT(11-1)-3045. 24p. AT.

The several objectives are briefly sketched, and then current progress is reviewed. Coding and testing of the SPHINX data processing code is nearly complete. The space–time reactor kinetics code FX-2 is fully operational. Coordination of the data processing codes MINX and SPHINX was enhanced and both codes were improved by the communication of cross section data, in the form of Version II CCCC Standard Interfaces ISOTXS and BRKOXS from LASL to ARD. Additional testing of the phone line hookup between ORNL and ARD was made by running of the VENTURE code. (1 figure, 2 tables) (RWR)

31324 OBSERVABILITY OF 2π ROTATIONS: A PROPOSED EXPERIMENT. Klein, A.G.; Opat, G.I. (School of Physics, University of Melbourne, Parkville, Victoria 3052, Australia). Phys. Rev. D 11: No. 3, 523-528 (1 Feb 1975).

Rotations by 2π radians of spin–1/2 systems are predicted to give rise to factors of -1 in the wave function. We propose an experiment involving Fresnel diffraction of thermal neutrons to test this proposition. (auth)

31325 PULSED-NEUTRON DECAY MEASUREMENTS ON BeO SYSTEMS IN THE VICINITY OF THE CONTINUUM BOUND. Sohrabpour, M.; Bull, S. R. (Univ. of Missouri, Columbia). Ann. Nucl. Sci. Eng.; 1: No. 6, 377-382(Jun 1974).

Decay constants have been measured in BeO systems in the buckling range 0.0167 to 0.0342 cm^{-2}. The corresponding decay constants range from below the constant collision frequency limit λ^*, to values above the elastic continuum bound, λ_{el}. A range of $\lambda_{el}(B^2)$ has been determined experimentally and the results are compared with calculated values based on cross-section data generated by the GASKET code. (auth)

31326 APPLICATION OF THE INVARIANT IMBEDDING METHOD TO THE TRANSPORT EQUATION. Iterative Acceleration Diagram. Quinnez, S. (Dijon Univ., 21 (France)). Compt. Rend., Ser. A, B; 279: No. 1, 21-23(1 Jul 1974). (In French).

The invariant imbedding method is applied to the case of neutron flux transmission in a uranium plate of thickness X, irradiated on one face by a beam of thermal neutrons. The aim is to determine the fluxes transmitted and reflected with their energy spectrum. (FR)

31327 EXPERIMENTAL STUDY OF THERMALIZATION OF NEUTRONS IN A CYLINDRICAL SHELL. Rehman, A. Toronto; Univ. of Toronto (1971). 175p.

Thesis.

The basis of this study was the measurement of activations for a set of five detectors, ^{55}Mn, ^{197}Au, ^{115}In, ^{239}Pu and ^{176}Lu, inside the central fuel rod and the surrounding moderator at 20 cm hexagonal lattice-pitch in the heavy water-moderated, natural uranium critical reactor ZEEP. From Kushneriuk's computer programmes FINAL and KUSHFLUX, based on his approximate and semi-analytic calculations for the distribution and energy spectrum of thermal and epithermal neutron fluxes in a weakly neutron capturing cylindrical shell, the neutron flux distribution was obtained. This calculated neutron flux distribution was used in the author's computer programme ACTIVE to obtain predicted detector activations. The measured and calculated detector activations from FINAL and KUSHFLUX, when compared, gave good agreement in the moderator, with the exception of points near and inside the fuel rod. The discrepancy varied between 4 and 6% (for KUSHFLUX) and 5 to 7% (for FINAL) for the average activation in the fuel rod and from 2.5 to 6% (for KUSHFLUX) and 3.5–5.0% (for FINAL) for the activation at the surface of the fuel rod. The measured detector activations were also compared with the predicted values obtained from the HAMMER code. The average activation in the fuel rod agreed to within ±1.5–6%, and the activation at the surface of the fuel rod agreed to within ±0.5–2.5%, with the experimental values. (CA)

31328 NATIONAL NUCLEAR DATA LIBRARIES. Badescu-Singureanu, A. I.; Deciu, N.; Gheorghe, D.; Mateescu, N.; Mateescu, S.; Rapeanu, S. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 9, 981-991(1974). (In Rumanian).

The main problem of the organization of the evaluated nuclear data computerized libraries for reactors, the solutions adopted by the most important national libraries [ENDF (U.S.A.), UKNDL (G. B.), KEDAK (F. R. G.)], and the general organization of the Romanjan evaluated microscopic nuclear data library "DANEM-I" from the I.A.P. are presented. (1 figure) (auth)

31329 NEUTRON WAVE PROPAGATION IN BERYLLIUM. Miles, R. E.; Bull, S. R.; Parkinson, T. F. (Univ. of Missouri, Columbia). Ann. Nucl. Sci. Eng.; 1: No. 6, 365-376(Jun 1974).

The propagation of thermal neutron waves has been studied in four beryllium parallelepipeds. The transverse bucklings of these parallelepipeds ranged from 0.0497 to 0.2572 cm^{-2}, values which are greater than the critical buckling (0.00116 cm^{-2}). From the space–time profiles, the dispersion law for beryllium was deduced over the frequency range $0 < \omega < 1000$ Hz. For the larger systems good agreement was found with calculations based on thermalization theory at frequencies less than 600 Hz. The effect of continuum contamination was apparent in all the systems, but in the larger blocks this contamination had about the same magnitude and attenuation as the discrete modes. For the smaller systems, the continuum contamination was associated with neutrons having energies below the Bragg cut-off and was manifested by oscillations in the complex inverse relaxation lengths at the higher frequencies. (auth)

31330 EVALUATED NUCLEAR DATA FILES. Pearlstein, S. (Brookhaven National Lab., Upton, NY). Advan. Nucl. Sci. Technol.; 8: 115-139(1975).

The discussion of evaluated nuclear data files covers the definition of evaluated data, the dilemma of the evaluator, computerized files, the use of evaluated nuclear data files, a description of evaluated nuclear data files, and procedures for data evaluation. (JFP)

31331 QUASI-EXPONENTIAL DECAY OF NEUTRON FIELDS. Corngold, N. (California Inst. of Tech., Pasadena). Advan. Nucl. Sci. Technol.; 8: 1-46(1975).

The review of quasi-exponential decay of neutron fields includes thermal neutrons, a multiplying system, experiments on simple and complex thermal systems and fast systems, and theory for the time- or space-dependent decay constant, and the full solution. (JFP)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 30386, 30953, 31016, 31092, 31364, 31365, and 31404.

31332 (CONF-740822-(Absts.)) INTERNATIONAL CONFERENCE [ON] FEW BODY PROBLEMS IN NUCLEAR AND PARTICLE PHYSICS, UNIVERSITE LAVAL, QUEBEC, AUGUST 27–31, 1974. Summaries of Contributed Papers. (Laval Univ., Quebec City (Canada)). Aug 1974. 134p. (In English and French).

This collection of abstracts from the conference is divided into the following sections: general few-body problems; nucleon–nucleon interaction at all energies; meson–nucleon and meson–deuteron interactions, meson factory programs; nuclear bremsstrahlung, on-shell and off-shell interactions; final-state interactions; bound and scattering states, few-body forces; polarization phenomena; short-range correlations, quasi-free scattering; composite hadron models, subnucleon structure; multiparticle and coherent production processes, breakup reactions, electrodisintegration; and relativistic effects. (RWR)

31333 (COO-1265-154, pp 8-13) ODD-EVEN FEATURES IN $^3He + ^3H$ SCATTERING. Brown, R. E.; Chwieroth, F. S.; Tang, Y. C.; Thompson, D. R. Sep 1974.
In annual report 1974.

31334 (COO-1265-154, pp 14-16) NUCLEON-NUCLEON SPIN-ORBIT POTENTIAL IN CALCULATIONS OF $P + \alpha$ AND $^3He + \alpha$ SCATTERING. Furber, R. D.; Brown, R. E.; Tang, Y. C.; Thompson, D. R. Sep 1974.
In annual report 1974.

31335 (COO-1265-154, pp 17-21) PHASE-SHIFT ANALYSIS OF $^3He + ^4He$ SCATTERING. Koepke, J. A.; Brown, R. E. Sep 1974.
In annual report 1974.

31336 (COO-1265-154, pp 21-24) PAULI REPULSIVE CORE IN $\alpha + \alpha$ SCATTERING. Brown, R. E.; Chien, W. S.; Tang, Y. C. Sep 1974.
In annual report 1974.

31337 (COO-1265-154, pp 25-34) THEORETICAL INTERPRETATIONS OF $\alpha + \alpha$ SCATTERING BELOW 15 MeV (C.M.). Chien, W. S.; Brown, R. E. Sep 1974.
In annual report 1974.

31338 (ITF-74-112P) THEORY OF HIGH ENERGY ELECTRON INTERACTION WITH THE NUCLEI ^3H AND ^3He. Tartakovskii, V. K.; Kozlovskii, I. V.; Foursat, A. D. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The influence of three-nucleon nuclei clusterization on their properties as well as on high energy electron scattering by nuclei is studied. The wave functions and the energies of ^3H and ^3He with the clusterization on nucleon and deuteron taken into account are calculated using the interpolation approach. The form factors, meson-square radii, and magnetic momenta of ^3H and ^3He and also the coulomb energy of ^3He are calculated with these functions. It is shown that taking into account the nuclei clusterization betters the agreement of the form factors calculated and the mean-square radii with experimental ones. The cross section of the two-particle electrosplitting of ^3H and ^3He is considered taking into account the nuclei clusterization and the interactions in final state performed on the basis of the interpolation approach. Good agreement with the available experimental data on two-particle electrosplitting of ^3He is obtained. The cross section of three-particle electrosplitting of ^3H and ^3He is calculated taking into account the exact kinematics of the process using the nuclear wave functions of the K-harmonic method. The contribution of states of the mixed symmetry to the wave functions of ^3H and ^3He is studied as well as the influence of interaction in final state on the behavior of the cross section of total electrosplitting of three-nucleon nuclei. (auth)

31339 ANALYSIS OF $^3He(d,d)^3He$ SCATTERING. Levshin, E. B.; Nemets, O. F.; Yasnogorodskii, A. M. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1685-1690(Aug 1974). (In Russian).

The differential cross sections and all components of the analyzing power for deuteron scattering on ^3He in the energy range from 8 to 14 MeV were calculated by using the optical potential, including spin-orbit and tensor terms. A comparison was made of the calculated results with experimental data, and the role of the tensor terms of the potential was discussed. (3 figures, 3 tables) (tr-auth)

31340 FINITE-ENERGY SUM RULES FOR HADRON-NUCLEUS SCATTERING. Alberi, G. (Univ., Trieste, Italy); Grossman, Z.; Leon, J.; Osland, P. Nuovo Cim., A; 25A: No. 2, 353-376(21 Jan 1975).

The possibility of extracting information about the hadron-nucleus scattering amplitude, using finite-energy sum rules and a comparison amplitude with well defined analytical properties are discussed. As examples the real parts of the forward π^4He and $\pi^{12}C$ scattering amplitudes, using only total cross sections determined over a finite energy range, are calculated. The determined values compare favorably with experimental results and the most recent dispersion relation analysis. Furthermore, the asymptotic corrections to the Glauber approximation are determined for the same two cases. The correction to the real part is found to be significant, as predicted by the Fresnel correction to the Glauber amplitude. (auth)

31341 CORRECTIONS TO THE NUCLEAR GOLDBERGER-TREIMAN RELATION AND PIONIC FORM FACTORS. Kim, C.W.; Townsend, J.S. (Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218). Phys. Rev. D 11: No. 3, 656-663 (1 Feb 1975).

A general discussion on the corrections to the nuclear Goldberger-Treiman (GT) relation and their relationship to pionic nuclear form factors is given. The corrections are related to meson-exchange corrections to the Gamow-Teller matrix element and the correction to the pion propagator in nuclear matter. In general, corrections to the GT relation are found to be large, implying a substantial variation of the physical pion-nucleus coupling constant from its value for the zero-mass pion. The $^3He \rightarrow ^3H$ and $^{12}B \rightarrow ^{12}C$ transitions are considered in detail. Using the known contribution to the GT relation due to the deuteron-nucleon breakup mechanism, we obtain an estimate of remaining contributions for the $^3He \rightarrow ^3H$ transition. The induced pseudoscalar form factors are also calculated and the muon capture rates for the processes $\mu^- + ^3He \rightarrow ^3H + \nu_\mu$ and $\mu^- + ^{12}C \rightarrow ^{12}B + \nu_\mu$ are compared with experiment as a further test of second class currents. (auth)

31342 APPROXIMATE SOLUTION OF THE EQUATIONS OF THE MODEL DESCRIBING HIGHLY EXCITED STATES OF DOUBLY EVEN DEFORMED NUCLEI. Kyrchev, G.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 22: No. 2, 244-252(Feb 1975). (In Russian).

An extension of the model suggested earlier for the description of intermediate and highly excited states of odd deformed nuclei to the case of doubly even nuclei is made. The wave function contains one-, two-, three- and four-phonon terms. The approximate solution taking into account the noncoherent pole terms is used to obtain approximate solutions of the model. The system of equations is reduced to a secular equation which does not contain superfluous solutions. The equations obtained may serve as a basis for studying the structure of intermediate and highly excited states of doubly even deformed nuclei. (auth)

31343 PION ABSORPTION EFFECTS IN THE REACTION $^3H(\pi^+,\pi^0)^3He$. Eisenberg, J. M.; Mandelzweig, V. B. (Hebrew Univ., Jerusalem (Israel). Dept. of Physics). Phys. Lett., B; 53: No. 5, 405-408(6 Jan 1975).

It is shown that in Glauber theory the angle-integrated cross-section for $^3H(\pi^+,\pi^0)^3He$ has no peak as a function of energy through the 3,3 resonance region, this result suggesting a direct measurement to elucidate the nature of (π^+,π^0) reactions. (auth)

31344 PHOTODISINTEGRATION OF ^3He INTO 3 NUCLEONS. de la Ripelle, M. F.; Levinger, J. S. (Institut de Physique Nucleaire, Orsay, France). Nuovo Cim.; 25A: No. 4, 555-570(21 Feb 1975).

The lowest hyperspherical harmonic is used to find the wave function for the 1^-, isospin-$\frac{1}{2}$ state reached by E1 transitions. The Ballot-Beiner-Fabre wave function is used for the ^3He ground state. The calculated cross section is in agreement with Fetisov's measurements of photodisintegration into three nucleons for photon energy from 18 to 85 MeV, but too low a cross section below 18 MeV is found. (auth)

31345 E2 TRANSITION AND SUCCESSIVE CONSIDERATION OF HIGHER ORDER CORRECTIONS IN THE MODEL OF A RIGID ASYMMETRICAL ROTATOR. Fedorov, A. D.; Dobromyslov, M. B. (Khabarovsk Polytechnic Inst., USSR). Yadern. Fiz.; 20: No. 5, 868-872(Nov 1974). (In Russian).

Studying E2 transitions in the model of a rigid asymmetrical rotator one uses not only the corrections due to the β^3 terms in the Hamiltonian but as well the corrections caused by higher order terms in the β expansion of the quadrupole momentum operator. Ratios of E2 probabilities turn to be close to the values of Davydov-Filippov model, thus observed departures from the predictions of the model seem to be related to still higher order corrections ($\sim\beta^4$) in the Hamiltonian. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 30462, 30939, 30942, 31316, 31340, 31341, 31387, 31390, 31397, 31413, 31434, 31440, 31582, 31591, 31592, and 31609.

31346 (CEA-CONF-2765) COMPOUND NUCLEUS FORMATION IN THE $^{12}C(^{14}N,^6Li)^{20}Ne$ REACTION. Volant, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1973. 8p. (CONF-740133-3). Dep. NTIS (US Sales Only) $4.00.

From 12th winter meeting on nuclear physics; Villars, Switzerland (21 Jan 1974).

The present quantitative analysis proves that the main process of the $^{12}C(^{14}N,^6Li)^{20}Ne$ is through compound nucleus formation at very different incident energies. Also the yrast line of aluminum-

26 at high excitation energies is studied. For this purpose the excitation functions were measured at 40 to 60 MeV for neon-20 levels. The cross sections are also discussed. The Hauser–Feshbach theory was used in the data analysis. (JFP)

31347 (CEA-CONF-2766) (e,e'p) REACTIONS AT 500 MeV. Mougey, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1973. 17p. (CONF-740133-2). Dep. NTIS (US Sales Only) $4.00.

From 12th winter meeting on nuclear physics; Villars, Switzerland (21 Jan 1974).

The analysis of (e,e'p) experiments at an incident energy of 500 MeV on carbon-12, silicon-28, calcium-40, and nickel-58 is presented. The cross sections, spectral functions, and momentum distributions are discussed. PWIA and DWIA analyses are carried out. (JFP)

31348 (CEA-R-4641) DIFFERENTIAL CROSS SECTIONS FOR NEUTRON ELASTIC AND INELASTIC SCATTERING BY CARBON FROM 8.0 TO 14.5 MeV. Haouat, G.; Lachkar, J.; Sigaud, J.; Patin, Y.; Cocu, F. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Feb 1975. 55p. (In French). Dep. NTIS (US Sales Only) $5.75.

Differential cross sections for fast neutrons scattered by carbon were measured between 8.0 and 14.5 MeV in steps of 0.5 MeV. The angular distributions for elastic and inelastic scattering to the first excited level in ^{12}C were obtained by using the neutron time-of-flight facility of the Centre d'Etudes de Bruyères-le-Châtel tandem Van de Graaff accelerator. The uncertainties vary from 7 to 15% for the differertial elastic-scattering cross sections and from 8 to 20% for the differential inelastic-scattering cross sections. These data extend to higher energies previous (n,n'γ) measurements on carbon (between 5.8 and 8.8 MeV), also performed in this laboratory. The comparison of these values with previously reported data, below 9 MeV and around 14 MeV, shows good agreement. No other experimental contribution seems to have been reported, yet, between 9 and 14 MeV. The sum of the integrated cross sections for the elastic and inelastic scattering presented here and the previously published cross sections of the $^{12}C(n,\alpha_0)^9Be$ and $^{12}C(n,n'3\alpha)$ reactions are compared with the total cross sections measured elsewhere. The excitation functions for the elastic and inelastic (1st excited level) scattering by carbon are also compared with the evaluated values of ENDF/B-III. These evaluated values are not in agreement with the present experimental results. (10 figures, 32 tables) (auth)

31349 (CONF-750303-10) CROSS SECTIONS FOR THE PRODUCTION OF LOW ENERGY PHOTONS BY NEUTRON INTERACTIONS WITH FLUORIDE AND TANTALUM. Dickens, J. K.; Morgan, G. L.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Differential cross sections for the production of low-energy photons (< 240 keV) by neutron interactions in fluorine and tantalum were measured for neutron energies between 0.1 and 20 MeV. Photons were detected at 92° by using an intrinsic germanium detector. Incident neutron energies were determined by time-of-flight techniques for a white source spectrum. (6 figures) (auth)

31350 (CONF-750303-18) NEUTRON TOTAL CROSS SECTION OF ^6Li FROM 10 eV TO 10 MeV. Harvey, J. A.; Hill, N. W. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 2p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Transmission measurements were made at ORELA on two metal samples of ^6Li(98.72%) with inverse sample thicknesses of ^6Li of 11.99 and 2.987 b/atom. The measurements at low energies (from 10 eV to 300 keV) were made by using a ^6Li glass scintillation detector at 17.878 m and 78.203 m and at high energies (from 50 keV to ~10 MeV), by using an NE-110 scintillation detector at 78.203 m. The total cross section data from both samples and detectors are in good agreement and are believed to be accurate to 1 to 2% below 1 MeV. Total cross section data obtained from both samples at ~25 discrete energies up to 1 MeV by using an iron-filtered beam are in good agreement with the continuous spectra data. (2 figures, 1 table) (auth)

31351 (CONF-750303-21) OBSERVATION AND ANALYSIS OF ELASTIC NEUTRON SCATTERING FROM ^{12}C. Holt, R. J.; Smith, A. B.; Whalen, J. F. (Argonne National Lab., Ill. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Angular distributions of neutrons elastically scattered from ^{12}C were measured from 1.8 to 4.0 MeV at intervals of ≥20 scattering angles distributed between 20 to 160 deg. Incident neutron energy resolutions were 20 to 50 keV. All differential cross sections were determined relative to those of the H(n,n) reaction. In addition, total neutron cross sections were deduced from monoenergetic ($\Delta E \simeq 2$ keV) neutron transmissions in the energy range 1.5 to 5.0 MeV. The experimental results were interpreted in terms of a multilevel R-matrix analysis including considerations of previously reported cross sections and polarizations. The resulting R-matrix parameters are compared with the Yale values deduced from observed scattered neutron polarizations. The measured values and analysis suggest physically consistent standard carbon total and scattering cross sections readily referenced in measurement applications. (auth)

31352 (COO-1195-296) COHERENT SCATTERING AND COHERENT THREE PION PRODUCTION FROM BOTH THE GROUND STATE AND THE FIRST EXCITED STATE OF CARBON AT 6 GeV/c. Wojslaw, R. J. (Illinois Univ., Urbana (USA). Dept. of Physics). Jul 1974. Contract AT(11-1)-1195. 105p. Dep. NTIS $8.25.

Thesis.

A study was made of the following coherent interactions on carbon nuclei at 6 GeV/c: $\pi^-C \to \pi^-C^*_{4.44}$, $\pi^-C \to \pi^-C$, $pC \to pC^*_{4.44}$, $pC \to pC$, $\pi^-C \to \pi^+\pi^-\pi^-C^*_{4.44}$. The notation $C^*_{4.44}$ denotes the $J^P = 2^+$ excited state of the carbon nucleus at 4.44 MeV. Results reported include differential cross sections, integrated cross sections, nuclear density-matrix elements, and the spin–parity composition of the 3π system. (16 figures, 10 tables) (auth)

31353 (COO-1265-154, pp 35-41) STUDY OF LOW LYING TWO-PARTICLE STATES IN ^{18}O WITH THE $^{17}O(d,p)^{18}O$ REACTION. Li, T. K.; Dehnhard, D.; Brown, R. E. Sep 1974.

In annual report 1974.

31354 (JINR-E4-8445) APPLICATION OF THE SINGULARITY SUBTRACTION METHOD FOR (d,p) REACTIONS ON LIGHT NUCLEI. Borbely, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

The applicability of the singularity subtraction method to the analysis of (d,p) reactions is demonstrated. By using the structure information given by the subtraction method, one can make "traditional" mechanism studies more effective. (2 figures, 2 tables) (auth)

31355 (LA-UR-75-294) FOURTEEN-MeV, NEUTRON INDUCED GAMMA-RAY PRODUCTION CROSS SECTIONS FOR SEVERAL ELEMENTS. Arthur, E. D.; Drake, D. M.; Silbert, M. G.; Young, P. G. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 5p. (CONF-750303-4). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A pulsed 14.2-MeV neutron source and a NaI(Tl) gamma-ray spectrometer were used to measure gamma-ray production cross sections for several elements from in the range A = 12 to 239. Angular distributions for some of the more prominent gamma ray groups were obtained. Complete gamma-ray production cross sections were measured for all the sample materials, including those in which no clearly separable gamma ray groups appeared. (auth)

31356 (LA-UR-75-344) R-MATRIX ANALYSIS OF THE LIGHT ELEMENT STANDARDS. Hale, G. M. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 8p. (CONF-750303-17). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The application of multilevel, multichannel R-matrix theory to the analysis of reactions in light nuclear systems is outlined. The discussion then specializes to describe analyses of reactions in the ^7Li and ^{11}B systems, which contain (n,α) cross sections widely used as neutron standards. Comprehensive R-matrix analyses which were incorporated in Version IV of the Evaluated Nuclear Data File (ENDF/B-IV) for neutron reactions from ^6Li and ^{10}B are described; the reactions and data analyzed, the resulting parameters, and predicted cross sections are given. The effects of new experimental information on the ENDF/B-IV results are discussed for both lithium and boron. Particular attention is given to the perplexing question of determining the $^6Li(n,\alpha)$ cross section in the region of the 240 keV resonance. Suggestions for further experimental work are given. (11 figures, 2 tables) (auth)

31357 (RLO-1388-266) PRODUCTION OF ^{6}Li, ^{9}Be, AND ^{10}B IN p + ^{13}C REACTIONS AT LOW ENERGIES. Oberg, D. L.; Bodansky, D.; Chamberlin, D.; Jacobs, W. W. (Washington Univ., Seattle (USA). Dept. of Physics). 1974. 31p. Dep. NTIS $4.75.

Cross sections were measured for the production of ^{6}Li, ^{9}Be, and ^{10}B in proton reactions on ^{13}C, at energies extending from threshold to 18 MeV. The reaction products were identified by time-of-flight techniques, and total cross sections were determined by integrating over the measured angular distributions. Although the typical abundance of ^{13}C in nature is small compared to that of ^{12}C, ^{14}N, or ^{16}O, the ^{13}C reactions may have a significant role in the production of the light elements because of their low Q values. Even for a ^{12}C/^{13}C ratio as low as the terrestrial ratio of 0.01, the inclusion of ^{13}C contributions is found to reduce appreciably the 7/6, 11/10, and Li/Be abundance ratios calculated for interactions at low energies between protons and a representative mixture of C, N, and O. Overall, this reduction brings the abundance ratios calculated at proton energies below 25 MeV closer to the observed solar system ratios. (10 figures) (auth)

31358 (RLO-1388-267) ELASTIC AND INELASTIC SCATTERING OF ^{18}O BY ^{16}O AND ^{18}O. Vandenbosch, R.; Reisdorf, W. N.; Lau, P. H. (Washington Univ., Seattle (USA)). 19 Jul 1974. 26p. Dep. NTIS $4.50.

Angular distributions were measured for the elastic and inelastic scattering of ^{18}O by ^{16}O and ^{18}O at laboratory bombarding energies of 42 and 52 MeV. The inelastic scattering data were analyzed in terms of collective excitations by using a coupled-channels approach. Deformation parameters were obtained for the strongly excited states. The relationship between the strength of inelastic scattering and the amount of structure in the elastic scattering distributions is discussed. (11 figures, 2 tables) (auth)

31359 (RLO-1388-272) PARITY MIXING IN ^{19}F. Adelberger, E. G.; Swanson, H. E.; Cooper, M. D.; Tape, J. W.; Trainor, T. A. (Washington Univ., Seattle (USA). Dept. of Physics). 1974. 11p. Dep. NTIS $4.00.

The parity-violating asymmetry of the 110-keV deexcitation radiation emitted by a polarized ensemble of ^{19}F nuclei in the first excited state is found to be $\delta = -(1.8 \pm 0.9) \times 10^{-4}$. (2 figures) (auth)

31360 POLARIZATION OF PROTONS ELASTICALLY SCATTERED ON ^{7}Li AND ^{11}B NUCLEI. Deineko, A. S.; Mashkarov, Yu. G.; Slabospitskii, R. P.; Zalyubovskii, I. I.; Bezvershuk, B. S.; Malakhov, I. Ya. (Kharkov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1694-1697(Aug 1974). (In Russian).

The polarization of protons elastically scattered on ^{7}Li and ^{11}B was measured in the incident proton energy interval from 1.8 to 3.0 MeV. The energy and angular dependence of the polarization were determined and shown graphically for ^{7}Li. The excitation functions for elastic scattering of polarized protons on ^{11}B were determined. Anomalies observed at 2.0 and 2.6 MeV correspond to previously detected resonances. (3 figures) (JSR)

31361 THE PHOTONEUTRON CROSS SECTION OF ^{9}Be. Hughes, R. J.; Sambell, R. H.; Muirhead, E. G.; Spicer, B. M. (Melbourne Univ., Parkville (Australia). School of Physics). Nucl. Phys., A; 238: No. 2, 189-198(3 Feb 1975).

The absolute total cross section for photoneutron production from ^{9}Be has been deduced from bremsstrahlung yield curves measured from threshold to 28 MeV. Neutron yields were measured using direct neutron counting and were analyzed using the variable-bin Penfold-Leiss method. The integrated cross section to 17.8 MeV is 13 ± 1 MeV·mb; and to 27.5 MeV is 28.3 ± 3 MeV·mb. Detailed comparison between experiment and various shell model calculations show some points of agreement either at lower energies or in the GDR but there is no one overall satisfactory detailed version. More refined and detailed calculations are required. (auth)

31362 EVIDENCE FOR CRITICAL ANGULAR MOMENTA IN THE FORMATION OF ^{26}Al VIA THE ^{14}N + ^{12}C CHANNEL. Volant, C.; Conjeaud, M.; Harar, S.; Lee, S. M.; Lepine, A.; da Silveira, E. F. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). Nucl. Phys., A; 238: No. 1, 120-140(27 Jan 1975).

States in ^{20}Ne have been studied through the ^{12}C(^{14}N,^{6}Li)^{20}Ne reaction. Excitation functions have been measured from 20 MeV to 60 MeV in steps of 5 MeV at different angles for ^{20}Ne states up to 10 MeV excitation energy. States of ^{24}Mg have been also populated using the ^{12}C(^{14}N, d)^{24}Mg reaction; excitation functions of ^{24}Mg states up to 9 MeV excitation energies as well as angular distributions at 35 MeV bombarding energy have been obtained. Comparisons of data with Hauser-Feshbach calculations show clearly that the compound nucleus mechanism is the main process for both ^{12}C(^{14}N, ^{6}Li)^{20}Ne and ^{12}C(^{14}N, d)^{24}Mg reactions. Strong evidence has been provided for inhibition of the ^{26}Al compound nucleus formation for angular momenta higher than critical values. The location of the yrast line in the ^{26}Al nucleus is discussed. (auth)

31363 MAGNETIC ELASTIC ELECTRON SCATTERING FROM ^{13}C. Lapikas, L.; Box, G.; de Vries, H. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). v.2 p.460-463 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

An experiment is described of 180° scattering of electrons from ^{13}C. The primary concern of this work is the determination of parameters of the ground-state magnetization distribution of this nucleus. The scattering angle of 180° was chosen in order to minimize the charge scattering which dominates the magnetic scattering at other angles. The incident energy was varied between 40 and 90 MeV. (auth)

31364 DESCRIBING ^{8}Be BY THE GENERATOR COORDINATE METHOD FOR SCATTERING. Beck, R.; Borysowitz, G.; Brink, D. M.; Mihailovic, M. V. (Oxford Univ. (UK). Dept. of Theoretical Physics). v.2 p.245-248 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The generator coordinate method (GCM) offers a framework for the calculation of nuclear scattering and reaction amplitudes in terms of the nucleon-nucleon interaction, taking properly into account the Pauli principle. A few open questions related to the way of using the GCM for scattering are discussed, and the method is applied to elastic ^{4}He + ^{4}He scattering. (auth)

31365 SEARCH FOR THE PARITY-FORBIDDEN HEAVY-PARTICLE WIDTH $\Gamma^{T}_{d\alpha}$ OF THE E_x = 3.562 MeV STATE IN ^{6}Li. Barrette, J.; Del Bianco, W.; Depommier, P.; Kundu, S.; Marquardt, N.; Richter, A. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire). Nucl. Phys., A; 238: No. 1, 176-188 (27 Jan 1975).

Alpha-particle capture by deuterium has been investigated at excitation energies in ^{6}Li close to the $J^{\pi} = 0^{+}$, T = 1, E_x = 3.562 MeV state. A search for resonance γ-rays from this state has yielded a negative result and an upper limit for the heavy-particle width $\Gamma^{T}_{d\alpha} \leq 0.017$ eV. (auth)

31366 GIANT QUADRUPOLE AND OCTUPOLE RESONANCES IN ^{12}C: RESONANCE EFFECTS IN ^{12}C($\vec{p}$,p')^{12}C*(1^{+},12.7 MeV). Geramb, H. V. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). v.2 p.290-293 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Giant quadrupole and octupole resonances in ^{12}C are determined from an analysis of the differential cross sections for 61-MeV proton inelastic scattering on ^{12}C. The giant resonance is treated as a quasi-bound final state. The results are compared with results obtained from photonuclear reactions. (NL)

31367 HIGH LYING STATES IN ^{12}C BY INELASTIC SCATTERING OF PROTONS. Buenerd, M.; Martin, P.; Saintignon, P. de; Loiseaux, J. M (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). v.2 p.286-289 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The high-lying continuum of ^{12}C has been investigated up to 30 MeV excitation energy by proton inelastic scattering at incident energies of 45 and 155 MeV. The experiment was performed on the Grenoble variable energy cyclotron. Particles were detected using a $\Delta E - E$ (600 μm - 10 mm) silicon counter telescope cooled at liquid-N_2 temperature, and protons were selected by a standard Goulding-type particle identifier. Spectra were recorded between

7.5 and 170°. The overall resolution was 150 keV, essentially due to the target thickness (3 mg/cm²) and kinematical effects. (auth)

31368 AN DWBA ANALYSIS OF POLARIZATION OF NEUTRONS FROM THE $^{12}C(d,n_0)^{13}N$ REACTION IN THE DEUTERON ENERGY RANGE 2.80 TO 3.35 MeV. Bondouk, I. I. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Nuclear Physics). Atomkernenergie; 24: No. 2, 135-136(1974).

The polarization of neutrons from the $^{12}C(d,n_0)^{13}N$ reaction was analyzed in terms of the DWBA theory in the deuteron energy range 2.80 to 3.35 MeV. (auth)

31369 CROSS-SECTIONS FOR THE (γ,n) REACTION IN ^{9}Be, ^{12}C, AND ^{16}O AT 60 MeV PHOTON ENERGY. Schier, H.; Schoch, B. (Univ., Mainz). Lett. Nuovo Cim.; 12: No. 10, 334-336(8 Mar 1975).

An experimental result is obtained for the cross section ratio between transitions to the ground and excited states for the (γ,n) reaction in ^{12}C and ^{16}O. Furthermore in a search for the dependence of the cross section on the binding energy of the last bound neutron, measurements on ^{9}Be were performed. The differential cross sections are given for these reactions at 61.25 to 63.0 MeV. (JFP)

31370 (π^-,^{12}C) ELASTIC BACKWARD SCATTERING. Barbini, R. (CNEN, Rome); Guaraldo, C.; Scrimaglio, R.; Balestra, F.; Busso, L.; Garfagnini, R.; Piragino, G. Lett. Nuovo Cim.; 12: No. 10, 359-364(8 Mar 1975).

The differential cross sections for negative pion elastic scattering by carbon-13 at 69 to 87.5 MeV are found. (JFP)

31371 EXCITATION OF LOW LYING LEVELS OF ^{10}B NUCLEUS AT FAST ELECTRON INELASTIC SCATTERING. Tartakovskii, V. K.; Fursaev, A. V.; Kobrinskii, Yu. V. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 11, 1821-1825(Nov 1974). (In Russian).

The inelastic electron form factors of a ^{10}B nucleus corresponding to excitation of low-lying levels are calculated. The probabilities of transverse transitions are calculated in many-body shell model with intermediate coupling and LS-coupling. The energy electron spectra are obtained at inelastic scattering by the ^{10}B nuclei at 180°. Comparison with available experimental data is made. (auth)

31372 PROTON-INDUCED REACTIONS WITH ^{9}Be BETWEEN 6.5 AND 9.5 MeV. Wild, L. W. J.; Crinean, G. B. (Univ. of Melbourne, Parkville, Australia). Aust. J. Phys.; 27: No. 5, 663-666 (Oct 1974).

Excitation functions for the reactions $^{9}Be(p,p_0)^{9}Be$, $^{9}Be(p,p_2)^{9}Be^*$ (2.43 MeV), $^{9}Be(p,d_0)^{8}Be$, and $^{9}Be(p,\alpha_0)^{6}Li$ were measured at 60°, 105°, and 140°. With the exception of a resonance observed in the elastic scattering channel at 6.5 MeV, no resonant structure was found in any excitation function. (auth)

31373 HEAVY-ION REACTIONS WITH NUCLEON TRANSFER. Osman, A. (Cairo Univ.). Nuovo Cim.; 25A: No. 4, 571-592 (21 Feb 1975).

Heavy-ion reactions with nucleon transfer were reconsidered on the basis of a Coulomb-stripping direct-reaction model. At low energies, the distortion motions between the interacting particles in the initial and exit channels are represented by Coulomb wave functions. Analytical expressions for the differential cross sections are developed for heavy-ion reactions with nucleon transfer. For the sake of comparison the angular distributions for a variety of nuclear transfer reactions are calculated at energies below, in the range of, and above the Coulomb barrier between the heavy interacting ions. The present fitting to the experimental data shows the importance of Coulomb distortion and its large effect especially at large angles. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 30942, 30962, 31316, 31347, 31355, 31362, 31402, 31405, 31413, 31440, 31446, 31451, 31527, and 31572.

31374 (CEA-CONF-2856) CALCULATION OF (n,n'γ) CROSS SECTIONS FROM 2 TO 7 MeV NEUTRON ENERGY FOR LIGHT NUCLEI. Duchemin, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1973. 4p. (CONF-740320-5). Dep. NTIS (US Sales Only) $4.00.

From EANDC topical meeting; Tokyo, Japan (27 Mar 1974).

Cross sections for the production of deexcitation gamma rays following inelastic neutron scattering were calculated for silicon, chromium, and nickel isotopes from threshold to 7.0 MeV. The statistical model with width fluctuation corrections was used taking into account only the Q = 0 correction. The optical model was also used. Differential cross sections and excitation functions are plotted. (JFP)

31375 (CONF-750303-2) NEUTRON CAPTURE MECHANISM IN LIGHT AND CLOSED SHELL NUCLIDES. Allen, B. J.; Boldeman, J. W.; Kenny, M. J.; Musgrove, A. R.; Pe, H. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Physics Div.); Macklin, R. L. (Oak Ridge National Lab., Tenn. (USA)). 1974. 4p. Dep NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

High resolution neutron capture cross section measurements were made at the Oak Ridge Electron Linear Accelerator on Al, Si, ^{40}Ca, ^{52}Cr, ^{90}Zr and ^{138}Ba for the energy range above 2.5 keV. These data were analyzed at Lucas Heights where capture measurements with Ge(Li) and Moxon-Rae detectors have provided complementary information. While valence model calculations are important for these nuclides in explaining the shape of the γ-ray spectra and the observed correlation between reduced neutron and radiative widths, the valence component cannot adequately account for the observed radiative widths and a substantial single particle component, uncorrelated with neutron widths, is required. (auth)

31376 (CONF-750303-8) GAMMA-RAY PRODUCTION MEASUREMENTS DUE TO INTERACTIONS OF NEUTRONS WITH ELEMENTS REQUIRED FOR NUCLEAR POWER APPLICATIONS AND DESIGN. Chapman, G. T.; Dickens, J. K.; Love, T. A.; Morgan, G. L.; Newman, E. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

For the past three years neutron-induced gamma-ray production cross sections have been made for a variety of elements at the Oak Ridge Electron Linear Accelerator. A large, well shielded, NaI spectrometer was used as the gamma-ray detector and ORELA, as the neutron source. The facility provides a consistent data set for neutron energies from 0.7 to 20 MeV and photon energies from 0.3 to 10.5 MeV. Typically, the samples are flat plates of the element of ≈ 0.02 atoms/barn thickness, although several elements studied required samples in compound form. The data are accumulated in a two-parameter array, gamma-ray pulse height versus neutron time-of-flight. Data reduction was accomplished by binning in desired neutron-energy groups and in fixed photon-energy groups. For each neutron-energy group the data were unfolded by using FERD unfolding routine, and the results are in the form of absolute differential cross sections, $d^2\sigma/d\omega dE$, for each photon-energy bin. So far data have been obtained for 20 elements (Li, C, N, O, F, Mg, Al, Si, Ca, Fe, Ni, Cu, Zn, Nb, Ag, Sn, Ta, W, Au, and Pb). (6 figures, 1 table) (auth)

31377 (COO-1265-154, pp 43-50) COUPLED-CHANNEL-BORN-APPROXIMATION ANALYSIS OF $^{20}Ne(p,t)^{18}Ne$ TRANSITIONS. Olsen, D. K. (Univ. of Texas, Austin); Udagawa, T.; Brown, R. E. Sep 1974.

In annual report 1974.

31378 (COO-1265-154, pp 51-52) MICROSCOPIC DESCRIPTION OF INELASTIC ^{3}He SCATTERING ON ^{24}Mg AND ^{28}Si. Morsch, H. P.; Dehnhard, D. Sep 1974.

In annual report 1974.

31379 (COO-1265-154, pp 53-60) INELASTIC α-PARTICLE SCATTERING ON ^{24}Mg, ^{28}Si, ^{30}Si, AND ^{32}S AT FAR FORWARD ANGLES. Dehnhard, D.; Morsch, H. P.; Dudek-Ellis, A.; Ellis, P. J.; Li, T. K.; Artz, J.; DeLong, R. Sep 1974.

In annual report 1974.

31380 (COO-1265-154, pp 61-75) DESCRIPTION OF 4^+ STATES IN ^{24}Mg AND ^{26}Mg. DeLong, R.; Dehnhard, D. Sep 1974.

In annual report 1974.

31381 (COO-1265-154, pp 82-90) EFFECTIVE MATRIX ELEMENTS OF THE TWO-BODY INTERACTION FROM AN ANALYSIS OF THE (^{3}He,d) REACTIONS ON ^{28}Si AND ^{29}Si. Dykoski, W. W.; Dehnhard, D. Sep 1974.

In annual report 1974.

31382 (COO-1265-154, pp 98-99) MONOPOLE TRANSITIONS IN THE INELASTIC α SCATTERING ON ^{24}Mg AND ^{28}Si. Morsch, H. P.; Dehnhard, D.; Li, T. K. Sep 1974.

In annual report 1974.

31383 (COO-1265-154, pp 132-136) PROTON STRIPPING INTO ^{29}Si AND ^{30}Si USING THE (^{16}O,^{15}N) REACTION AT 60

MeV. Dehnhard, D.; Weber, D.; Shkolnik, V.; Artz, J.; DeVries, R. Sep 1974.
In annual report 1974.

31384 (COO-2324-3) RECOIL PROPERTIES OF ^{11}C AND ^{18}F PRODUCED IN THE INTERACTION OF 11.5-GeV PROTONS WITH ^{27}Al. Progress Report. (Illinois Univ., Chicago (USA)). [nd]. 2p. Dep. NTIS $4.00.
In a stacked-foil experiment, the difference in activity between the end and central foils is a measure of the amount of recoil in the forward (F) and backward (B) directions. The quantities F/B and 2W(F+B), where W is the foil thickness, are tabulated for ^{11}C, ^{18}F, and ^{24}Na resulting from p + ^{27}Al reactions at 11.5 GeV. (1 table) (RWR)

31385 (JINR-P4-8525) ENERGIES OF STATES OF ALPHA-CLUSTER NUCLEI IN THE sd SHELL IN BRINK'S MODEL. Kinchakov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 22p. (In Russian). Dep. NTIS (US Sales Only) $4.25.
Energies of states of the nuclei ^{20}Ne, ^{24}Mg, ^{28}Si, and ^{32}S are calculated. Alpha-particle structure of the nucleus ^{24}Mg, which was found earlier in the analysis of the charge form factors of electron scattering, is confirmed. The absolute value of the binding energy of the D_{3d} structure of the ^{20}Ne nucleus calculated with the Brink–Boeker force is smaller than the binding energy of triangle bi-pyramidal configuration of alpha clusters by 16 MeV. The metastable state of the D_{2h} structure of the nucleus ^{32}S is found. (4 figures, 4 tables) (auth)

31386 (JINR-P15-8482) SPIN-FLIP AT INELASTIC SCATTERING OF PROTONS BY ^{28}Si NUCLEUS. Wang Sung Chan; Golubev, S. A.; Komsan, M. N. Kh.; Kurepin, A. B.; Likhosherstov, V. N.; Osetinskii, G. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.
Energy and angular dependence of the spin-flop probability was measured as well as the differential cross section of inelastic scattering of protons at resonance energies E_p = 3.095 and 3.334 MeV in the $^{28}Si(p,p')^{28}Si^*$ (2^+, 1.78 MeV) reaction. The energy dependence of the spin-flip probability was found to be of resonance nature. The angular distribution of inelastic scattering and of spin-flip probability is asymmetric relative to 90° in the center of mass system. (auth)

31387 (ORO-3924-19, pp 1-5) HEAVY ION FUSION. Namboodiri, M. N.; Chulick, E. T.; Natowitz, J. B.; Das, K.; Webb, L. 1974.
In angular momentum effects in nuclear reactions. Progress report, January 1, 1974–December 31, 1974.
The fusion of Al, Cr, and Ni nuclei with nitrogen-14 projectiles having kinetic energies of 157 and 262 MeV was studied. Cross sections were determined for the production of the residual heavy nuclei which result from the evaporative de-excitation following fusion of the projectile and target nuclei. Limiting angular momenta for the production of nonfissioning compound nuclei were extracted from those cross sections. (JFP)

31388 BRANCHING RATIOS AND LIFETIMES OF ^{25}Mg LEVELS BETWEEN 5.2 AND 6.1 MeV. Ollerhead, R. W.; Kean, D. C.; Leong, S. G. T.; Doekes, C.; Meadley, T. M. R. (Univ. of Guelph, Ont.). Can. J. Phys.; 53: No. 2, 123-132(15 Jan 1975).
All levels between 5.2 and 6.1 MeV in ^{25}Mg were studied using the reaction $^{25}Mg(p,p'\gamma)$. Inelastically scattered protons were detected in an annular surface barrier detector located at 180°; coincidence gamma-ray spectra were obtained at Ge(Li) detector angles of 90, 45, and 135°. Level energies were determined from unshifted gamma-ray energies recorded in the 90° spectra. Lifetimes were obtained from the attenuated Doppler shift of gamma-ray energies recorded in spectra taken at forward and backward angles. Branching ratios were deduced from the combined data of all three angles. The identification of levels as members of rotational bands is discussed, and transition strengths deduced from the present measurements are compared with predictions of the simple rotational model. In particular, evidence is presented for the identification of a level at 5535 keV as the $11/2$ member of the ground state band, levels at 5522 and 5794 keV as the $5/2$ and $11/2$ members of the $K^\pi = 1/2^-$ band, and a level at 6040 keV as the $11/2$ member of a $K^\pi = 9/2^+$ band. (auth)

31389 STUDY OF THE $^{30}Si(^3He,p)^{32}P$ REACTION. Nann, H.; Friedland, U.; Hubert, B.; Patscher, W. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik); Wildenthal, B. H. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Phys., A; 238: No. 1, 111-119(27 Jan 1975).
The $^{30}Si(^3He,p)^{32}P$ reaction was studied at an incident energy of 28 MeV, and angular distributions were measured for states in ^{32}P up to 3.00 MeV of excitation energy. Comparison of the experimental differential cross sections with two-nucleon-transfer distorted-wave Born-approximation (DWBA) calculations was made to test different sets of wave functions, which were calculated in the same configuration space but with different treatments of the effective residual interaction. (auth)

31390 SEARCH FOR PARITY-NONCONSERVATION IN THE $^{19}F(p,\alpha_0)^{16}O$ REACTION. Krimmelbein, N.; Schober, H.; Waeffler, H. (Max-Planck-Institut fuer Chemie (Otto-Hahn-Inst.), Mainz (F. R. Germany). Kernphysikalische Abt.). v.2 p.434-437 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).
From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).
At present nothing is known about the isospin dependence of the weak, parity-nonconserving internuclear potential which is responsible for the small, parity-violating effects observed in nuclei. Therefore, a search for the parity nonconserving alpha decay from excited states of ^{20}Ne to the ground state of ^{16}O may shed some light on this isospin dependence. The best experimental approach to these states is given by resonant proton capture in ^{19}F. Two sharp resonances from the $^{19}F(p,\alpha\gamma)^{16}O$ reaction, at 340 and 670 keV proton energy, characterize the formation of levels in ^{20}Ne. An upper limit for the α_0-particle emission width of the 340 keV resonance of $\Gamma_{\alpha 0} \lesssim 7 \times 10^{-6}$ eV is found. (auth)

31391 A TEST OF EFFECTIVE INTERACTIONS WITH ^{26}Mg. Glaudemans, P. W. M.; Koops, J. E.; Meurders, F. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.); Cole, B. J. (Glasgow Univ. (UK). Dept. of Natural Philosophy). v.2 p.107-110 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).
From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).
Effective interactions are tested for the $J^\pi = 0^+$ ground states and the $J^\pi = 2^+$ first excited states of ^{24}Mg and ^{26}Mg. Electromagnetic properties and spectroscopic factors are calculated for these nuclei by using different matrix elements. A modification of the matrix elements solely on the basis of obtaining better agreement with experimental energies leads to improved wave functions. (NL)

31392 COINCIDENT HIGH-VELOCITY DSA LIFETIME MEASUREMENT OF $^{34}S(1)$. Hermans, J. A. J.; Engelbertink, G. A. P.; van Driel, M. A.; Eggenhuisen, H. H. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). v.2 p.532-535 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).
From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).
Coincident high-velocity DSA line-shape measurements are reported for ^{34}S. Thin 200 $\mu g/cm^2$ TiT targets on a 0.3 mm backing are bombarded with a 38-MeV $^{32}S^{6+}$ beam of about 300 nA from the Utrecht EN tandem accelerator. The targets have a protective layer of 45 $\mu g/cm^2$ Al. Proton groups with ≃ 150 keV resolution are detected in an annular Si counter at 180° which is shielded from elastically scattered ^{32}S ions by a 12 μm thick mylar foil. The γ-ray patterns are observed with a 25% efficient Ge(Li) detector at 0° in coincidence with protons, this arrangement enabling the selection of the excited state of the recoiling ions. A value of $\tau_m = 6.48 \pm 0.02$ ps is obtained. (auth)

31393 A STUDY OF TWO-STEP PROCESSES THROUGH PARTICLE–GAMMA RAY CORRELATIONS: $^{28}Si(d,p)^{29}Si(5/2^+)$. Boyd, R. N.; Kaminstein, J. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). v.2 p.392-395 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).
From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).
The $^{28}Si(d,p)^{29}Si(5/2^+, 2.03$ MeV) reaction has been studied to examine the effects of two-step processes on this reaction. Sensitivity to these processes would allow the determination of pieces of the wave function not normally obtained in direct-reaction studies. The angular correlation setup at the University of Rochester was used to measure the proton–γ-ray angular correlations. Targets were self-supporting Si foils of 300 $\mu g/cm^2$ thickness. Six γ-ray detectors were used in arbitrary coincidence with four particle detectors, with a timing resolution of about 4 ns. The incident deuteron energy was 7.6 MeV. (auth)

31394 THE $^{24}Mg(^{6}Li,d)^{28}Si$ REACTION: THEORY AND EXPERIMENT. Draayer, J. P.; Gove, H. E.; Trentelman, J. P.; Anantaraman, N.; Collins, H. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). v.2 p.388-391 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The microscopic structure of the low-lying states in ^{28}Si has been the subject of extensive theoretical and experimental investigation. Results presented here are for alpha particle stripping strengths to states below 6.69 MeV obtained a) theoretically by exploiting the goodness of the SU_6-SU_3 quantum numbers in describing the initial and final states in the target and residual nuclei and b) experimentally from both zero-range and exact finite-range (EFR) DWBA analyses of $^{24}Mg(^{6}Li,d)^{28}Si$ data taken with a 36-MeV ^{6}Li beam from the MP Tandem at the University of Rochester. (auth)

31395 ISOSCALAR QUADRUPOLE AND OCTUPOLE STRENGTH IN ^{24}Mg THROUGH INELASTIC ALPHA SCATTERING. Singh, P. P.; Yang, G. C. (Indiana Univ., Bloomington (USA)); van der Woude, A.; Drentje, A. G. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versneller Instituut). v.2 p.298-301 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Results are reported of measurements, with good resolution, of inelastic alpha scattering from ^{24}Mg, which were made with a view to explore the distribution of quadrupole and octupole strengths both among the discrete excited states and in the continuum. The measurements were carried out using the 70-MeV momentum-analyzed alpha beam from the K.V.I. Cyclotron. Inelastically scattered α-particles from 0.5-1.1 mg/cm^2 thick targets of enriched (>99%) ^{24}Mg were detected in a $\Delta E-E$ detector telescope with an overall resolution of 70-100 keV. The cross sections were measured over an angular range of 7° to 103° in 2°-4° steps and have an absolute accuracy of 7%. (auth)

31396 MEASUREMENTS OF THE PROTON SPIN-FLIP PROBABILITY AT $^{24}Mg(p,p')$ RESONANCES. Golubev, S. L.; Kurepin, A. B.; Likhosherstov, V. N.; Topilskaya, N. S. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij); Osetinsky, G. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 53: No. 5, 445-448(6 Jan 1975).

The proton spin-flip probability has been found to have a non-resonance energy dependence in the region of isolated resonances for proton inelastic scattering on ^{24}Mg. This is accounted for by the assumption that the background processes are negligible. A numerical estimate of the validity of the single-level approximation has been carried out, and partial widths have been obtained. (auth)

31397 GIANT SPIN FLIP RESONANCES AND GENERALIZED KURATH SUM RULE. Ueberall, H.; Nagl, A. (Catholic Univ. of America, Washington, D. C. (USA)); Lindgren, R.; Fagg, L. W. (Naval Research Lab., Washington, D. C. (USA)). v.2 p.310-313 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The strengths of giant resonance levels of spin flip character are calculated from the Kurath sum rule. The form factors are given by the Helm model. Cross sections are calculated for inelastic electron scattering at 100, 200 and 300 MeV on ^{12}C, ^{24}Mg and ^{58}Ni. (NL)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 30942, 31316, 31347, 31355, 31374, 31375, 31397, 31434, 31440, 31446, 31453, 31517, 31527, and 31592.

31398 (ANU-P-593) (d,t) REACTIONS ON ^{54}Cr, $^{67,68}Zn$ NUCLEI. Borsaru, M.; Nurzynski, J.; Gebbie, D. W.; Hollas, C. L.; Whineray, S.; Merrill, N. H.; Barbopoulos, L. O.; Quinton, A. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Oct 1974. 32p. Dep. NTIS (U. S. Sales Only) $4.75.

Levels in ^{53}Cr, $^{66,67}Zn$ were investigated using the (d,t) reaction at 12 MeV deuteron energy. Angular distributions were measured and spectroscopic factors obtained from a comparison with the DWBA predictions. A clear j-dependence which could be fitted with DWBA was observed for low lying $l_n = 1$ transitions in ^{67}Zn. A j-dependence for both $l_n = 1,3$ transitions in ^{53}Cr was also seen, neither of which could be reproduced by DWBA. Filling coefficients and center-of-gravity energies were obtained for ^{68}Zn and both compared to the predictions of the simple pairing theory. (auth)

31399 (ANU-P-605) GAMMA DECAYS, LIFETIMES AND SPINS OF ^{47}V EXCITED STATES. Thompson, J. V.; Bell, R. A. I.; Carlson, L. E.; Najam, M. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). 1 Nov 1974. 24p. Dep. NTIS (U. S. Sales Only) $4.25.

The nucleus ^{47}V was studied using the $^{47}Ti(p,n\gamma)^{47}V$ reaction, with isotopically enriched ^{47}Ti targets, incident proton energies from 4.7 to 5.4 MeV, and Ge(Li) gamma-ray detectors. The previously unreported gamma decay of the second excited state was observed. Energies of the first seven excited states were deduced to be 87.5 ± 0.1, 145.7 ± 0.2, 259.6 ± 0.4, 660.1 ± 0.3, 1138.3 ± 0.4, 1272.2 ± 0.4 and 1295.1 ± 0.4 keV. Their gamma-decay branching ratios were measured. The lifetimes of the last four mentioned states were deduced from attenuated Doppler shifts to be 680^{+1400}_{-340}, 960^{+1730}_{-440}, 390^{+390}_{-150}, and >750 fs respectively. Angular distribution measurements resulted in the assignment of $J^{\pi} = 9/2^-$ to the 1272 keV level and $J = 9/2$ or $11/2$ to the 1295 keV level. The results are discussed in the light of the Coriolis coupling model. (auth)

31400 (CEA-CONF-2769) $^{58}Ni(e,e)$ AT HIGH MOMENTUM TRANSFER. Bellicard, J. B.; Bernheim, M.; Bussiere de Nercy, A.; Frois, B.; Gillebest, A.; Huet, M.; Leconte, P.; Mougey, J.; Phan Xuan Ho; Royer, D.; Turck, S.; Sick, I. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1974. 3p. (CONF-740934-5). Dep. NTIS (US Sales Only) $4.00.

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The differential cross section was measured for the $^{58}Ni(e,e)$ reaction at 450 MeV. The resulting charge density is shown. It corresponds quite well with ones predicted by Hartree-Fock calculations using density-dependent forces. (2 figures) (RWR)

31401 (COO-1265-154, pp 94-97) STRUCTURE OF LOWEST 0^+ STATES IN $f_{7/2}$ SHELL NUCLEI FROM MONOPOLE TRANSITIONS IN INELASTIC ^3He SCATTERING. Morsch, H. P. Sep 1974.

In annual report 1974.

31402 (COO-1265-154, pp 100-102) SHELL EFFECTS IN COLLECTIVE EXCITATIONS IN A SHELL MODEL DESCRIPTION USING A RENORMALIZED EFFECTIVE INTERACTION. Morsch, H. P. Sep 1974.

In annual report 1974.

31403 (COO-1265-154, pp 103-105) TEST OF THE IMPORTANCE OF IMAGINARY FORM FACTORS IN A MICROSCOPIC DESCRIPTION OF INELASTIC ^3He AND α SCATTERING. Morsch, H. P. Sep 1974.

In annual report 1974.

31404 (CRN-PN-74-21) STUDY OF THE (t,d) REACTIONS ON f-p-SHELL NUCLEI IN SUB-COULOMB RANGE BETWEEN 2.0 AND 3.5 MeV. Bing, O. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). 1974. 169p. (In French). Dep. NTIS (US Sales Only) $11.50.

Thesis. Submitted to Strasbourg Univ., France.

Subcoulombian (t,d) reactions were systematically studied. Experimental results (structure of angular distributions, absolute cross section) are compared with theoretical predictions given by a DWBA analysis. In this formalism, at subcoulombian energies, nuclear information was extracted with a high degree of accuracy. The normalization factor D^2 which appears in the expression of the differential cross section is determined. This is carried out by studying (t,d) reactions on ^{52}Cr and ^{60}Ni and using the well known spectroscopic factors of the first excited states of ^{53}Cr and ^{61}Ni established by many authors in (d,p) reactions. The interest of this D^2 measure is two-fold: 1) test the different triton wave functions proposed in the literature, 2) measure spectroscopic factors in (t,d) reactions. This latter aspect is developed by studying the $^{45}Sc(t,d)^{46}Sc$ reaction. Little sensitivity to the choice of a reasonable set of optical potentials is shown by the differential cross section for this subcoulombian (t,d) process; this is not true for the $^{45}Sc(d,p)^{46}Sc$ reaction. How-

ever the absolute value of the spectroscopic factor from sub-coulombian (t,d) reactions is affected, as in (d,p) reactions, by ambiguities of the description of bound states. The systematic study is extended to the ^{40}Ca(t,d)^{41}Ca and ^{28}Si(t,d)^{29}Si reactions. In the first case a great sensitivity upon the choice of the ^{40}Ca (t,d)^{41}Ca elastic scattering description is shown by the analysis. In the second case resonances in excitation curves are observed. (FR)

31405 (JAERI-M-5714) GROUP CONSTANTS FOR THE keV CAPTURE OF STRUCTURAL MATERIALS Cr, Fe, AND Ni. Takano, H.; Ishiguro, Y. (Japan Atomic Energy Research Inst., Tokai). May 1974. 35p. Dep. NTIS (US Sales Only).

The effective capture cross sections of Cr, Fe and Ni are calculated in the energy range of 1.0 to 800 keV, and the group constants of ABBN type are given for the 70-group structure of JAERI-Fast Set. Through use of the various evaluated nuclear data, the uncertainties of these cross sections are investigated through comparisons of the group constants and analysis of the Doppler effects of stainless steel and natural iron samples. The uncertainties in the 1.15-keV resonance parameter of ^{56}Fe and in the smooth capture cross sections near the resonance energy are very large, and have important influence in the analysis of the Doppler coefficients. In the Doppler analysis, the results obtained with ENDF/B-III data are better than those with other data. The experimental values are well reproduced by raising the capture cross sections of iron in ENDF/B-III data by about 15% in the energy range of 1.0 to 800 keV. (auth)

31406 (KFK-2063) KeV NEUTRON RADIATIVE CAPTURE AND TOTAL CROSS SECTION OF ^{50,52,53}Cr, ^{54,57}Fe, AND ^{62,64}Ni. Beer, H.; Spencer, R. R. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Kernphysik). Oct 1974. 57p. Dep. NTIS (US Sales Only) $6.00.

Enriched samples of ^{50,52,53}Cr, ^{54,57}Fe, and ^{62,64}Ni were measured in capture and (with the exception of ^{53}Cr and ^{57}Fe) in transmission in the energy ranges 5 to 200 keV and 10 to 300 keV, respectively. The capture and total cross section data analyzed provided resonance parameters for both s- and (l > 0)-wave resonances. s- and p-wave strength functions were determined, and neutron width and level spacing distributions established. A positive correlation was found between the radiation widths and the reduced neutron widths. (19 figures, 18 tables) (auth)

31407 (LA-UR-75-340) DIFFERENTIAL CROSS SECTIONS FOR THE 0.847-MeV GAMMA RAY FROM IRON FOR INCIDENT NEUTRONS OF 8.5, 10.0, 12.2, AND 14.2 MeV. Drake, D. M.; Veeser, L. R.; Drosg, M.; Jensen, G. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 4p. (CONF-750303-12). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Neutron-induced differential gamma-ray production cross sections for the 0.847-MeV gamma ray from iron were measured using a pulsed ^{3}H(p,n)^{3}He neutron source and a NaI spectrometer. Background caused by break-up neutrons and Compton-scattered gamma rays was suppressed by placing the sample about one meter from the neutron source and using time-of-flight to select only pulses caused by the monoenergetic ^{3}H(p,n)^{3}He neutrons. (auth)

31408 (RLO-1388-264) ^{16,18}O ELASTIC SCATTERING FROM ^{58}Ni. Zisman, M. S.; DeVries, R. M.; Cramer, J. G.; Liu, K. L.; Chan, Y.; Cuengco, B. (Washington Univ., Seattle (USA). Dept. of Physics). 1973. 19p. Dep. NTIS $4.00.

The elastic scattering of ^{16}O + ^{58}Ni at 63.4 MeV and ^{18}O + ^{58}Ni at 63, 71.5, and 81 MeV was studied, and optical model fits were obtained. The data indicate that weakly absorbing optical potentials of the type used in some recent DWBA calculations are inconsistent with back-angle elastic scattering. A 5-parameter surface transparent optical potential with $a_I < a_R$ was found which reproduced the elastic scattering over this energy range and appeared to be capable of qualitatively reproducing the observed forward-peaked and oscillatory transfer reaction angular distributions in this mass region. (7 figures, 1 table) (auth)

31409 RPA-ORIENTED SHELL MODEL STUDY OF ^{56}Ni. Boiti, A.; Rimini, A.; Weber, T. (Univ., Trieste, Italy). Nuovo Cim., A; 25A: No. 3, 503-510(1 Feb 1975).

In the framework of the shell model it is shown that the role of the 3-particle–3-hole configurations in the excited states of ^{56}Ni is essential, as suggested by the RPA calculations. (auth)

31410 THREE-PARTICLE SPECTRA WITH EFFECTIVE INTERACTION INCLUDING SCREENING. Olsen, T. H.; Osnes, E. (Oslo Univ. (Norway). Fysisk Institutt). v.2 p.69-72 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The spectra of three particles in the 1s0d and 1p0f shells are calculated by using an effective interaction calculated by Kuo and Osnes and found to give good results for the corresponding two-particle spectra. This interaction is discussed in the context of past and present efforts to derive the effective interaction in nuclei. The $(1p0f)^3$ spectrum of ^{43}Sc is calculated. (auth)

31411 SELFCONSISTENT DESCRIPTION OF COLLECTIVE EXCITATIONS IN THE pf-SHELL. Muether, H.; Allaart, K. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.); Goeke, K.; Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). v.2 p.160-162 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Such pf-shell nuclei as ^{46,48}Ti, ^{50}Cr, ^{56}Fe show vibrational excitation spectra, the ratio $E(4^+)/E(2^+)$ being about 2.3 or 2.4. Hartree–Fock and Hartree–Fock–Bogoliubov calculations, however, yield deformed intrinsic states, and, when projecting onto good angular momenta and particle numbers, one obtains in most cases almost purely rotational spectra. By assuming a ^{40}Ca core the energy of the HFB solution was calculated as a function of deformation by constraining the wave function to a variable value of the intrinsic quadrupole moment. The Kuo interaction and single-particle energies from ^{41}Ca have been used. An attempt was made to mix the states projected from the prolate and oblate minima. (auth)

31412 OBSERVATION OF $T_0 + 1$ AND T_0 M1 STATES IN ^{58}Ni. Lindgren, R. A.; Bendel, W. L.; Jones, E. C. Jr.; Fagg, L. W.; Maruyama, X. K. (Naval Research Lab., Washington, D. C. (USA)); Lightbody, J. W. Jr.; Fivozinsky, S. P. (National Bureau of Standards, Gaithersburg, Maryland, USA). v.2 p.302-305 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

In ^{58}Ni a strong T = 2 M1 state predominantly of the form $[f_{\frac{5}{2}}^{-1} f_{\frac{7}{2}}]$ is predicted at 9.5 MeV excitation with a ground-state M1 width of 60 eV. In order to excite selectively this kind of state, back-angle inelastic electron scattering has been used, which is known to excite preferentially M1 states in the Sd shell. Inelastic electron spectra have been taken at the Naval Research Laboratory with the 180° magnetic spectrometer at 50 and 61 MeV and at 163° at electron bombarding energies of 40, 50, 60, and 75 MeV by using the National Bureau of Standards electron scattering facility. A comparison of the spectra between 163° and 180° taken at about the same bombarding energy is given. (auth)

31413 HOLE STRENGTH DISTRIBUTIONS FROM (e,e'p) REACTIONS. Bernheim, M.; Bussiere, A.; Gillebert, A.; Mougey, J.; Priou, M.; Royer, D.; Sick, I.; Wagner, G. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). v.2 p.412-415 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The results of a DWIA analysis of (e,e'p) experiments on ^{12}C, ^{28}Si, ^{40}Ca and ^{58}Ni performed at Saclay at an incident electron energy of 500 MeV are presented. Together with extraction of occupation numbers, mean removal energies and mean kinetic energies in an independent particle model for the target nucleus, a more general sum rule has been applied to get a quantitative test of a shell model description of nuclei. (auth)

31414 ^{58}Ni(e,e) AT HIGH MOMENTUM TRANSFER. Bellicard, J. B.; Bernheim, M.; Bussiere de Nercy, A.; Frois, B.; Gillebert, A.; Huet, M.; Leconte, P.; Mougey, J.; Phan Xuan Ho; Royer, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). v.2 p.457-459 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Elastic electron scattering at high momentum transfer has shown a structure of $\rho(r)$ beyond the average behavior of the usual models like the Fermi distribution. The interpretation of this structure in the framework of the shell model has been hampered by a lack of data at high momentum transfer. An experiment has been performed on a nucleus expected to have well-closed proton shells. ^{58}Ni seemed particularly well suited for such an investigation because of the relatively pronounced structure of $\rho(r)$ as predicted by shell model calculations. The density is expected to show two peaks at r = 0 and r = 2.5 fm, being due to the pronounced peaks of $2S_{\frac{1}{2}}$ and $1F_{\frac{7}{2}}$ radial wave functions. The results agree quite well with Hartree–Fock calculations. (auth)

31415 LEVEL PROPERTIES OF ^{50}V THROUGH THE ^{51}V(τ,α) REACTION. Majumder, A. R.; Chowdhury, M. S.; Sen Gupta, H. M. (Dacca Univ. (Bangladesh)); Guichard, A. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 238: No. 1, 1-28(27 Jan 1975).

The ^{51}V$(\tau,\alpha)^{50}$V reaction has been studied at E_τ = 18.0 MeV by using a multichannel magnetic spectrograph. Seventy levels up to an excitation of 9.3 MeV have been observed, including five analogues. The angular distributions have been analyzed in terms of the DWBA theory of direct reactions; a sum rule analysis has been made with the spectroscopic strengths thus obtained. The effects of non-locality and finite range in the optical potential and of the cut-off radius and optical model parameter sets were also studied. Except for a few levels, the l assignments agree well with previous neutron pick-up work; some new assignments of l values are also made. In addition to l = 0, 2 and 3 transitions, a few weak l = 1 transitions were also observed. (auth)

31416 THE HALF-LIFE FOR THE SUPERALLOWED FERMI BETA DECAY ^{50}Mn$(\beta^+)^{50}$Cr. Freeman, J. M.; Petty, R. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment); Hoath, S. D. (Oxford Univ. (UK). Nuclear Physics Lab.); Squier, G. T. A.; Burcham, W. E. (Birmingham Univ. (UK). Dept. of Physics). Phys. Lett., B; 53: No. 5, 439-441 (6 Jan 1975).

The half-life for the decay ^{50}Mn$(\beta^+)^{50}$Cr has been measured to be 282.8 ± 0.3 ms. This result is ~1% lower than the accepted value. It would bring the ft value for ^{50}Mn decay into agreement with recent measurements for other superallowed Fermi decays. (auth)

31417 (^{6}Li,d) SPECTROSCOPY IN THE f–p SHELL. Fulbright, H. W.; Strohbusch, U.; Markham, R. G.; Lindgren, R. A.; Morrison, G. C.; McGuire, S. C.; Bennett, C. L. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Phys. Lett., B; 53: No. 5, 449-451(6 Jan 1975).

It is seen that in the f–p shell the (^{6}Li,d) reaction is predominantly direct and that angular distributions can be fitted reliably with simple zero-range DWBA calculations for α-cluster transfer. Thus the reaction is established as a valuable spectroscopic tool. (auth)

31418 STRUCTURE OF THE LOW-LYING STATES OF ^{47}Ti. Dhar, A. K.; Kulkarni, D. R.; Bhatt, K. H. (Physical Research Lab., Ahmedabad (India)). Nucl. Phys., A; 238: No. 2, 340-364 (3 Feb 1975).

Deformed configuration-mixing calculations for the nucleus ^{47}Ti have been performed in the framework of the projected Hartree–Fock formalism. For each of the angular momentum states, the Hamiltonian has been diagonalized in the basis of about ten of the lowest orthogonalized projected states. The resulting spectrum is in good agreement with the observed spectrum of negative parity states. The eigenstates of the Hamiltonian have been analyzed for the possible existence of the "band structure". Besides the "ground state" K = ½ band of states with deformation $\delta \sim 0.15$, another well defined band of states belonging to the K = ½ neutron excited intrinsic state is likely to exist. The calculated and experimental binding energies are in good agreement. The results of the detailed calculation have been extrapolated to obtain an estimate of the level density for ^{47}Ti up to 6 MeV excitation energy. (auth)

31419 YRAST STATES IN ^{48}Cr AND REACTION MECHANISM OF THE ^{34}S + ^{16}O REACTION AT E_{lab} = 30 TO 36 MeV. Haas, B.; Taras, P.; Merdinger, J. C.; Vaillancourt, R. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire). Nucl. Phys., A; 238: No. 2, 253-268(3 Feb 1975).

The electromagnetic decays of the lower yrast states in ^{48}Cr have been studied via the ^{34}S(^{16}O,2n)^{48}Cr reaction, at incident ion energies of 30–36 MeV. At these energies pn, 2pn, αp, αn and 2n exit channels were open. The mechanism of the ^{34}S + ^{16}O reaction can be described by a statistical picture of the de-excitation process of the compound nucleus. As a result of angular distribution, excitation function, recoil distance and high resolution γ–γ and n–γ coincidence measurements the spins, parities and mean lifetimes (ps) of the following levels were established: 752 keV, 2^+, 16.7 ± 2.2; 1859 keV, 4^+, <5; 3534 keV, 6^+; 4064 keV, (8^+). These results cannot be accounted for by a pure $f_{\frac{7}{2}}$ configuration. They also possibly indicate that, at the 2^+ level, ^{48}Cr makes an angular-momentum-induced transition to a strongly deformed shape having a deformation $|\beta| \sim 0.30$. In addition, a backbending effect may be occurring in this nucleus. (auth)

31420 ANALOG STATES IN ^{52}Cr THROUGH PROTON CAPTURE BY ^{51}V. Roy, A.; Iyengar, K. V. K.; Jhingan, M. L.; Bhattacherjee, S. K. (Tata Inst. of Fundamental Research, Bombay). Pramana; 3: No. 3, 186-197(Sep 1974).

The γ-ray yield function was studied for proton capture by vanadium in the proton energy range 720 to 1300 keV. Isobaric analogs of low-lying states in ^{52}V were identified. At two resonances the γ spectra and γ-ray angular distributions were obtained, and the branching ratios and the multipole mixing ratios were deduced. The analog–antianalog M1 transition in ^{52}Cr was found to be strongly hindered, as in other $f_{\frac{7}{2}}$ nuclei. The Q value obtained for this reaction was (10500 ± 2.8) keV, and the Coulomb displacement energy was (8.06 ± 0.01) MeV. An upper limit of 2 MeV was obtained for the α-decay strength of the 11.395-MeV state in ^{52}Cr. (7 figures, 1 table) (auth)

31421 INVESTIGATION OF ANALOGUE STATES IN ^{55}Co. Martin, D. J. Kingston, Ont.; Queen's Univ. (1973). 149p. Thesis.

The nucleus ^{55}Co has been investigated via the ^{54}Fe(p,γ) and ^{58}Ni(p,$\alpha\gamma$) reactions. The γ-ray yield of the former reaction has been obtained up to a proton energy of 2.8 MeV. Eleven resonances have been investigated. Angular distribution, resonance strength and polarization measurements have been performed. Spins and parities of resonance and low-lying states have been assigned. Analogue states are identified, and the related Coulomb energy shifts, extracted. Reduced magnetic dipole transition rates are presented. Calculations of reduced M1 transition rates using a restricted number of shell model configurations are carried out and are seen to reproduce closely the experimental values. A derivation of the relation between a β^+-decay ft value and a specific part of the isovector magnetic dipole transition rate is presented and used to calculate log ft values. The numbers so obtained are in good agreement with experiment. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 30939, 31355, 31374, 31398, 31404, 31406, 31456, 31460, 31512, 31513, 31527, and 31570.

31422 (AD-784957) EVALUATION OF NEUTRON AND PHOTON-PRODUCTION CROSS SECTIONS FOR NATURAL COPPER. Final Report, 15 March 1973–14 March 1974. Drake, M. K.; Fricke, M. P. (Science Applications, Inc., La Jolla, Calif. (USA)). 11 Jul 1974. Contract DNA001-73-C-0126. 101p. (SAI-74-535-LJ). NTIS $4.50.

This report describes the data sources and methodologies used to prepare evaluated neutron and photon-production cross sections for natural copper. (GRA)

31423 (AED-CONF-73-313-001) DETERMINATION OF THE CROSS SECTION OF Ni-63 FOR PILE NEUTRONS. Neubert, A. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Nuklearchemie). 1973. 3p. (In German). (CONF-7306103-1).

Pile neutron cross sections of ^{63}Ni and isotopic abundance of nickel are given. The result is sigma (^{63}Ni) = (25.7 ± 3) barn. (1 figure, 1 table) (GE)

31424 (CEA-CONF-2767) WHAT CAN BE LEARNED FROM ONE- AND TWO-PROTON TRANSFER REACTIONS INDUCED BY ^{12}C AND ^{16}O ON ^{64}Ni AND ^{76}Ge TARGETS? Lemaire, M. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1974. 28p. (CONF-740133-1). Dep. NTIS (US Sales Only) $4.50.

From 12th winter meeting on nuclear physics; Villars, Switzerland (21 Jan 1974).

Angular distributions of the ^{64}Ni(^{12}C, ^{11}B)^{65}Cu and ^{64}Ni(^{16}O, ^{15}N)^{65}Cu reactions were measured and a DWBA analysis was performed. The spectroscopic factors are discussed. The preliminary observation of very peculiar angular distributions for the ^{76}Ge(^{16}O, ^{14}C)^{78}Se reaction suggests that two-step process via inelastic scattering can be important in transfer reactions induced by heavy ions. (JFP)

31425 (CEA-R-4636) EVALUATION OF THE NUCLEAR CROSS SECTION FOR THE REACTION $^{89}Y(n,2n)^{88}Y$ FROM THRESHOLD TO 20 MeV. Philis, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Feb 1975. 54p. (In French). Dep. NTIS (US Sales Only) $5.75.

A preliminary evaluation of the nuclear cross section for the reaction $^{89}_{39}Y(n,2n)^{88}_{39}Y$ was completed from threshold to 20 MeV. It was based only on experimental results. The recommended values were determined after analysis, selection, and normalization of the results to a consistent set of standards. The evaluated data are discussed and compared with theoretical values. The adopted errors span almost all the experimental values selected. (12 figures, 14 tables) (auth)

31426 (COO-3255-8) SINGLE-PARTICLE STATES OF ^{173}Lu OBSERVED IN DECAY OF ^{173}Hf. Brenner, D. S.; Kishore, R.; Meyer, R. A. (Clark Univ., Worcester, Mass. (USA). Jeppson Lab. of Chemistry; California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. 19p. Dep. NTIS $4.00.

The level scheme of ^{173}Lu as populated by the decay of 23.9-h ^{173}Hf was studied using Ge(Li) detectors in singles and coincidence γ-ray spectrometers. The coincidence data provide strong support for nearly all the previously proposed levels. Singles data obtained with a Compton-suppression spectrometer have enabled one to identify very weak transitions which were not seen by previous experimenters. Some of these transitions are used to establish new levels at 721.56, 734.63, 1359.32 and 1408.90 keV, and arguments are presented for assignment of these levels as the $1/2$[660], $1/2$[523], $3/2$[402] and $1/2$[400] Nilsson states. (auth)

31427 (JINR-P15-8202) GAMMA-DECAY OF $P_{\frac{1}{2}}$ AND $F_{\frac{5}{2}}$ ANALOG RESONANCES IN ^{61}Cu. Kraft, O. E.; Naumov, Yu. V.; Sizov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Gamma spectra for resonance decay in the reaction $^{60}Ni(p,\gamma)^{61}Cu$ at proton energies E_p = 1674, 1856, and 1873 keV were measured. For each resonance there are presented the decay scheme, relative intensities of the direct level population, partial gamma widths, and corresponding values of B(M1). (5 figures, 5 tables) (auth)

31428 (KAPL-P-4020) NEUTRON CROSS SECTIONS OF ^{59}Ni. Kirouac, G. J.; Eiland, H. M. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). 1975. Contract W-31-109-eng-52. 17p. (CONF-750303-24). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Pile oscillation and neutron total cross section measurements were made for neutron reactions with nickel-59. The thermal absorption cross section, resonance integral, and resonance parameters were found. (JFP)

31429 (LUIP-CR-74-14) PION AND PROTON EMISSION IN INTERACTIONS INDUCED BY RELATIVISTIC HEAVY NUCLEI WITH $Z \geq 12$. Jakobsson, B.; Kullberg, R.; Otterlund, I. (Lund Univ. (Sweden). Fysiska Institutionen). Oct 1974. 33p. Dep. NTIS (US Sales Only) $4.75.

The emission of pions and protons in interactions between heavy nuclei from the cosmic radiation ($12 \leq Z \leq 26$) and photoemulsion nuclei has been studied. The angular and energy distributions of target protons are similar to corresponding distributions in proton-nucleus interactions for emission angles $\geq 30°$. In heavy ion interactions a forward peak of high-energy target protons ($E \geq 200$ MeV) is observed. The energy spectrum of target protons for angles $<30°$ is remarkably flat for heavy ion interactions. For increasing disintegration of the target nucleus the number of produced pions per emitted recoil target proton is almost constant in heavy ion interactions, while it decreases rapidly in proton-nucleus interactions. The log tg θ distributions of pions have small standard deviations, even in interactions with a large target disintegration. (auth)

31430 (LUNP-7415) ISOBARIC ANALOGUE STATES EXCITED IN THE $^{59}Co(p,\gamma)^{60}Ni$ REACTION. Erlandsson, B.; Lyttkens, J.; Marcinkowski, A. (Lund Univ. (Sweden). Fysiska Institutionen). Sep 1974. 32p. Dep NTIS (US Sales Only) $4.75.

The $^{59}Co(p,\gamma)^{60}Ni$ reaction has been investigated in the proton energy region E_p = 1365-2150 keV. Decay schemes and branching ratios have been determined for ten resonances, five of which have been identified as possible analogues or fragments of analogues of the ground state (5^+) and the 58.6 keV (2^+), 277.1 keV (4^+), 288.4 keV (3^+), and 435.7 keV (5^+) levels in ^{60}Ni. At eight of the resonances most of the decay seems to go via a group of states with an excitation energy of 5-9 MeV. The investigated analogue states give a Coulomb displacement energy of 9118 ± 7 keV. (auth)

31431 (ORNL-tr-2799) OBSERVATION OF HIGH-ENERGY PIONS IN THE COLLISION OF RELATIVISTIC DEUTERONS WITH NUCLEI. Baldin, A. M.; Giordenesku, N.; Zubarev, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1971. Translation of JINR-P1-5819. 10p. Dep. NTIS $4.00.

A simpler multibaryon collision d + Cu → π^- + . . . at a pion energy substantially exceeding one-half of the kinetic energy of deuterons was determined. The differential cross sections were found. (JFP)

31432 (UCRL-51705) GAMMA-GAMMA DIRECTIONAL CORRELATION STUDIES IN ^{77}Ge DECAY. Lent, E. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Nov 1974. Contract W-7405-Eng-48. 165p. Dep. NTIS $11.25.

Thesis.

The decay properties of the levels in ^{77}As were investigated following the decay of 11.3-hour ^{77}Ge. Singles γ-ray energy and intensity measurements were obtained with a 54-cm^3 high-resolution Ge(Li) detector. Extensive $\gamma-\gamma$ coincidence and directional correlation measurements were obtained with large coaxial Ge(Li) detectors. An improved decay scheme was constructed. From $\gamma-\gamma$ correlation measurements, deduced log ft values, and internal conversion coefficients, the J^π values for the following levels were confirmed: g.s., $3/2^-$; 215.51, $3/2^-$; 264.41, $5/2^-$; 475.45, $9/2^+$; 614.49, $3/2^-$ or $5/2^+$; 631.82, $5/2^+$; 1189.81, $7/2^+$; and 1560.67, $5/2^+$. Further J^π values were proposed as follows: 194.75, $1/2^-$; 1528.32, $5/2^-$; 1538.80, $3/2^-$ or $5/2$; 2000.16, $5/2^+$; 2341.64, $5/2$ or $7/2$; 2354.12, $5/2$ or $7/2$; and 2543.70, $5/2$ or $7/2$. The following δ(E2/M1) mixing ratios were obtained: 215.51-keV, −0.164 ± 0.16 or −0.321 ± 0.011; 558.02-keV, −0.139 ± 0.006; 810.35-keV, 0.194 ± 0.030 or 2.37 ± 0.18; 928.85-keV, −0.63 ± 0.41; 1263.86-keV, −1.41 ± 0.06 or −0.079 ± 0.013; 1312.80-keV, −5.86 ± 1.7 or −1.03 ± 0.11; and 1368-keV, −21.0 ± 12.0 or 0.519 ± 0.49. (101 figures, 10 tables) (auth)

31433 (USIP-74-16) STATES OF HIGH SPIN IN ^{87}Sr, ^{88}Sr, AND ^{89}Sr. Arnell, S. E.; Nilsson, A.; Stankiewicz, O. (Stockholm Univ. (Sweden). Fysiska Institutionen). May 1974. 44p. Dep. NTIS (US Sales Only) $5.50.

The reactions $^{84}Kr(\alpha,n)$, $^{86}Kr(\alpha,3n)$, $^{86}Kr(\alpha,2n)$ and $^{86}Kr(\alpha,n)$ were used to populate excited states in ^{87}Sr, ^{88}Sr and ^{89}Sr. The de-excitation of these states was studied by in-beam γ-ray spectroscopy. A number of new high-spin states have been observed. Many ^{87}Sr and ^{89}Sr levels are interpreted as due to the coupling of a $g_{\frac{9}{2}}$ neutron hole and a $d_{\frac{5}{2}}$ neutron, respectively, to excited states of the core nucleus ^{88}Sr. Lifetime measurements have also been performed. (auth)

31434 (WANL-TME-782) ELASTIC AND INELASTIC CROSS SECTIONS FOR SOME REACTOR MATERIALS. Stevens, C. A.; Melnick, M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 May 1964. 38p. Dep. NTIS $5.00.

The purpose of this work was to compute a set of cross sections to be used directly in the GAM-I computer program. Elastic and inelastic matrix elements for multigroup calculations were obtained for fifteen reactor materials. Cross sections were obtained in a number of ways, including use of the optical model and Hauser-Feshbach theory. Elastic scattering cross sections and Legendre expansion coefficients are tabulated for the following elements and energy ranges: B, 10.0 MeV to 10.0 keV; Ni, 10.0 MeV to 400.0 eV; Ta, 10.0 MeV to 4.0 keV; Nb, 10.0 MeV to 0.040 MeV; and Mo, 10.0 MeV to 0.69 MeV. In addition, partial inelastic cross sections are given for Ni from 4.06 to 1.4 MeV. (6 tables) (RWR)

31435 LIFETIME AND MAGNETIC MOMENTS OF EXCITED STATES IN THE EVEN COPPER NUCLEI ^{62}Cu, ^{64}Cu, AND ^{66}Cu. Ribbe, W. (Freie Univ. Berlin (F.R. Germany). Fachbereich Physik). 17 Mar 1972. 81p. (In German). INIS.

Available from the library of the Freie Univ. Berlin.

Magnetic moments of excited isomeric states in even copper nuclei were determined using the differential observation method of the Larmor precession, and simultaneously the lifetimes of these levels. The excited ^{64}Cu and ^{66}Cu nuclei were produced at the Berlin 7 MeV van-de-Graaff generator by the (d,p) reaction on the natural isotope mixture of copper, those of the ^{62}Cu nuclei by the reactions $^{61}Ni(d,n)^{62}Cu$ and $^{62}Ni(p,n)^{62}Cu$. Using Ge(Li) detectors, γ-spectra were registered promptly and with retardation to the beam pulse in time windows. With these spectra together with coincidence measurements, it was possible to complete the level scheme and in particular to clearly assign the delayed γ-quanta. (GE)

31436 COULOMB EXCITATION OF ^{61}Ni NUCLEUS. Andreev, D. S.; Erokhina, K. I.; Zvonov, V. S.; Lemberg, I. Kh.; Mishin,

A. S. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1661-1667(Aug 1974). (In Russian).

The γ spectra associated with Coulomb excitation of ^{61}Ni by 6.8-MeV α particles and 26-MeV ^{12}C ions were studied. The comparison of the experimental values of the reduced probabilities with the results of theoretical calculations based on the shell model with multi-particle configurations taken into account in the presence of a residual two-particle surface δ interaction showed discrepancies of a factor of four or more for the majority of levels. (1 figure, 3 tables) (tr-auth)

31437 LIFETIMES OF STATES IN ^{62,64}Cu AND ^{67,70}Ga. Carlson, L. E.; Najam, M. R.; Davidson, W. F.; Zuk, W. M.; Bell, R. A. I.; Thompson, J. V. (Australian National Univ., Canberra). Aust. J. Phys.; 27: No. 2, 147-156(Apr 1974).

The Doppler shift attenuation method of lifetime determination was employed following the ^{62,64}Ni(p,nγ)^{62,64}Cu and ^{67,70}Zn(p,nγ)^{67,70}Ga reactions. The lifetime of the ^{62}Cu state at 637 keV was found to be 220^{+400}_{-110} fs; lower limits of 230 and 250 fs were set for the levels a 426 and 548 keV respectively. For ^{64}Cu, a lower limit of 175 fs was set for both the 609 and 663 keV states. Lifetimes in ^{67}Ga were determined for the indicated levels as: 828 keV, 280^{+200}_{-100} fs; 911 keV, 370^{+300}_{-150} fs; 1412 keV, 900^{+3500}_{-400} fs; 1519 keV, 750^{+1800}_{-400} fs; 1555 keV, 190^{+90}_{-70} fs; 1639 keV, 150^{+90}_{-70} fs; 2041 keV, 150^{+70}_{-50} fs; and 2174 keV, 80^{+40}_{-30} fs. Lower limits of 600 and 110 fs were set on the lifetime values for the 1202 and 1978 keV levels respectively. Similarly, lower limits on the lifetimes of the ^{70}Ga levels at 1203 and 1245 keV were set at 320 and 720 fs, while values for the 1 12 and 1446 keV levels of ^{70}Ga were found to be 245^{+150}_{-90} and 390^{+510}_{-190} fs. (auth)

31438 REACTION (^{3}He,d) ON ^{69}Ga. Labrie, J. P.; Habib, E. E.; Preibisz, Z. (Univ. of Windsor, Ont.). Can. J. Phys.; 53: No. 2, 117-122(15 Jan 1975).

Excited levels of ^{70}Ge and proton holes in ^{69}Ga were investigated by means of the ^{69}Ga(^{3}He,d)^{70}Ge reaction at an incident beam energy of 22.5 MeV. Angular distributions were measured and are compared with the prediction of the distorted-wave-Born-approximation (DWBA) theory in order to obtain the spectroscopic strengths on each level. The number of proton holes in ^{69}Ga was obtained from the sum rule of the spectroscopic strengths. The vacancy probability U_j^2 and the center of gravity energy E_j for the $2p_{\frac{3}{2}}$, $1f_{\frac{5}{2}}$, and $2p_{\frac{1}{2}}$ subshells are: single particle orbitals $2p_{\frac{3}{2}}$, $1f_{\frac{5}{2}}$, and $2p_{\frac{1}{2}}$ with U_j^2 of 0.342, 0.957, 1.058 and E_j(MeV) of 0.926, 3.008, and 3.566 respectively. These are compared with the pairing model calculations. (auth)

31439 DECAY OF 8.0 MIN ^{74}Ga. Taylor, H. W. (Univ. of Toronto); Schulte, R. L.; Tivin, P. J.; Ing, H. Can. J. Phys.; 53: No. 2, 107-116(15 Jan 1975).

^{74}Ga was produced through the ^{74}Ge(n,p)^{74}Ga reaction using 94.48% enriched ^{74}Ge. The cross section for the reaction and the half-life of ^{74}Ga were measured. The energies and intensities of the γ rays emitted by ^{74}Ga were measured using Ge(Li) spectrometers. A revised level scheme for ^{74}Ge was deduced. (auth)

31440 EXCITATION OF GIANT RESONANCES BY INELASTIC ALPHA SCATTERING. Youngblood, D. H.; Moss, J. M.; Rozsa, C. M.; Bronson, J. D.; Bacher, A. D. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). v.2 p.294-297 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The giant resonance region has been studied in ^{12}C, ^{14}N, ^{16}O, ^{20}Ne, ^{24}Mg, ^{27}Al, ^{32}S, ^{36}Ar, ^{40}Ar, ^{40}Ca, ^{48}Ti, ^{56}Fe, ^{59}Co, ^{60}Ni, ^{66}Zn, ^{90}Zr, ^{94,96,100}Mo, ^{148,154}Sm, ^{159}Tb, ^{197}Au, and ^{208}Pb with inelastic scattering of 96- and 115-MeV alpha particles from the Texas A&M cyclotron. For all targets with $A \gtrsim 36$ the continuum region of the spectra are characterized by a peak at an excitation energy of about $63/A^{\frac{1}{3}}$ MeV followed by a region of approximately flat yield at higher excitation. This peak is interpreted as a state directly excited in inelastic scattering rather than a threshold or level density effect. The distribution is best fit by an $L = 2$ distorted-wave Born-approximation (DWBA) calculation requiring 54% of the E2 energy-weighted sum rule (EWSR), while about 3 times the monopole EWSR would be required to fit the data. (auth)

31441 GAMMA-RAY EMISSION FROM ^{84,87}Se AND ^{85,88}Br ISOTOPES. Hurdus, M. H.; Tomlinson, L. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Inorg. Nucl. Chem.; 37: No. 1, 1-9(Jan 1975).

Gamma-ray emission from ^{84}Se, ^{85}Se, ^{86}Se, ^{87}Se, ^{85}Br, ^{86}Br, ^{87}Br and ^{88}Br was studied over the energy range 300 to 7100 keV using a Ge(Li) detector. Selenium isotopes were separated from a mixture of fission products using high speed radiochemistry and the bromine daughters allowed to grow in. The large difference in half-life between ^{86}Se and ^{87}Se was used to distinguish between ^{86}Br(54 sec) and ^{87}Br(55 sec). New gamma lines were assigned to selenium isotopes as follows: a line at 498.5 ± 0.6 keV to ^{84}Se; thirty-seven lines to ^{85}Se; seven lines to ^{86}Se; two lines to ^{87}Se. At least 98 per cent of decay of ^{84}Se is found to go via the ground state of ^{84}Br(31.7 min). A partial decay scheme is proposed for ^{85}Se. The half-lives of ^{85}Se and ^{86}Se were found to be 31.4 ± 1.0 sec and 14.4 ± 1.0 sec, respectively. A line at 832 keV previously assigned to ^{85}Br was shown to be due to ^{90m}Rb + ^{90}Rb. Data for ^{88}Br are generally in agreement with previous findings but three new lines were observed at 6161.5 ± 2.0, 6722 ± 3 and 6768 ± 1.5 keV, which must represent new levels in ^{88}Kr. Only the strongest lines were observed in the decay of ^{87}Br and ^{88}Br and these are generally in agreement with previous work. (auth)

31442 THE SCATTERING OF SLOW NEUTRONS BY COBALT. Koester, L.; Knopf, K.; Waschkowski, W. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department). Z. Phys.; 271: No. 2, 201-206(Dec 1974).

Different techniques have been used to determine with slow neutrons the coherent scattering amplitude b_c and the total scattering cross section σ_{sc} of Co. We found for the bound atom $b_c = 2.78 + 0.04$ fm and for the free nucleus $\sigma_{sc} = 5.95 + 0.05$ barns. From these quantities, the spin state scattering amplitudes b+ and b– corresponding to the compound nucleus states of spin $I + \frac{1}{2}$ or $I - \frac{1}{2}$ have been determined as b+ = –2.78 ± 0.04 fm and b– = +9.91 ± 0.06 fm. These results are not in agreement with previous data, but they are found to be consistent with data obtained from resonance parameters. (auth)

31443 MASS AND CHARGE IDENTIFICATION OF THE LIGHT PRODUCTS OF THE REACTION ^{40}Ar + ^{nat}Ni. Gatty, B.; Guerreau, D.; Lefort, M.; Pouthas, M.; Tarrago, X.; Galin, J. (Paris-11 Univ., 91 - Orsay (France). Lab de Chimie Nucleaire); Cauvin, B.; Girard, J.; Nifenecker, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). J. Phys. (Paris), Lett.; 35: No. 9, L.117-L.119(Sep 1974).

The mass and charge of all the nuclei with $Z \leq 20$ produced in the reaction ^{40}Ar + Ni were identified. Cross sections and energy spectra indicate that the reaction proceeds essentially through a binary process, with neutron and charged particle evaporation. (FR)

31444 CONTRIBUTION OF GIANT SPIN CLUSTERS TO THE RESISTIVITY, NEUTRON SCATTERING CROSS SECTION AND SPECIFIC HEAT IN ALLOYS: APPLICATION TO Ni–Cu. Levin, K.; Mills, D. L. (California Univ., Irvine (USA). Dept. of Physics). J. Phys. (Paris), Colloq.; No. 4, 213-215(1974).

From colloquium on disordered metallic systems; Strasbourg, France (10 Sep 1973).

A simple model for a non-dilute alloy containing giant spin clusters is used to calculate the spin contribution to the resistivity, the neutron cross-section, and the specific heat C_V. The model is expected to be applicable to Ni–Cu alloys near the critical concentration for ferromagnetism. Reasonable, semiquantitative agreement with resistivity, elastic neutron scattering and low temperature specific heat measurements on Ni–Cu is obtained for a range of concentrations and temperatures. (FR)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 30386, 30942, 31316, 31355, 31375, 31376, 31434, 31440, 31490, 31491, 31512, 31513, 31517, 31527, 31572, 31589, 31627, and 31654.

31445 (AAEC/E-327) KeV NEUTRON RESONANCE CAPTURE IN BARIUM-135. Musgrove, A. R. deL.; Allen, B. J.; Macklin, R. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1974. 29p. Dep. NTIS $4.50.

The neutron capture cross section of ^{135}Ba was measured with high resolution at the Oak Ridge Electron Linear Accelerator in the energy range 3 to 100 keV. From over ninety observed resonances in the 3 to 6 keV energy range, the average resonance parameters obtained were $\langle\Gamma_\gamma\rangle = 150 \pm 20$ MeV, $\langle D\rangle = 39.3 \pm 4$ eV, and $10^4 S_l = 0.8 \pm 0.2$. The quoted radiation width and p-wave strength function also have a normalization error of ±20 per cent.

The method of separation of s- and p-wave populations by statistical methods is described. (9 figures, 1 table) (auth)

31446 (CEA-N-1768) GIANT RESONANCES. Bergere, R.; Carlos, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de la Physique). Jan 1975. 75p. (In French). Dep. NTIS (US Sales Only) $6.75.

Recently, a considerable amount of experimental data about the high-energy collective modes in nuclei (giant resonances) has been published. The observed energies for these giant resonances agree with those proposed in the Bohr–Mottelson collective model. These experimental data are summarized here according to the method used to excite the giant resonances: by absorption of real photons, by radiative capture of protons and alpha particles, by inelastic scattering of hadrons, by virtual excitation of nuclei, by inelastic scattering of electrons, and by capture of μ^- and π^- mesons. (45 figures, 6 tables, 108 references) (auth)

31447 (CONF-750303-20) THRESHOLD PHOTONEUTRON SPECTROSCOPY OF NUCLEI NEAR A = 140. Holt, R. J.; Jackson, H. E. (Argonne National Lab., Ill. (USA)). [nd]. Contract W-31-109-Eng-38. 5p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The E1 and M1 radiative strength functions were measured for nuclei with atomic mass number near A = 140 and at an excitation energy of approximately 9 MeV by using the threshold photoneutron technique. A method was developed for extracting the dipole strength even though the first excited state of the daughter nucleus is near the ground state. The photoneutron spectra were measured at laboratory angles of 90° and 135° and with high resolution (0.5 ns/m) by using the time-of-flight spectrometer associated with the Argonne high-current linac. In particular, the dipole strengths found in ^{138}Ba and ^{140}Ce are discussed. These results are compared with theoretical estimates and with the radiative strengths of nuclei in the mass range 50 < A < 250. (5 figures) (auth)

31448 (CONF-750303-33) ^{94}Nb(n,γ)^{95}Nb, ^{95m}Nb REACTION FOR THE CTR REACTOR TECHNOLOGY PROGRAM. Persiani, P. J.; Pennington, E. M.; Harker, Y. D.; Heath, R. L. (Argonne National Lab., Ill. (USA)). [nd]. 5p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Depending on the assumptions made of the neutron cross section behavior in the high energy region, the captures in ^{94}Nb were found to be the major components influencing the afterheat and radioactivity in fusion reactor design problems. Preliminary blanket designs indicate that about 60% of the capture rates in ^{94}Nb occur above 1 keV and 90% occur above 100 eV. Therefore an important and timely cross section need is an estimate and measurement of the ^{94}Nb(n,γ)^{95}Nb, ^{95m}Nb reaction in the keV-MeV energy region. Nuclear level systematic studies using the two known positive energy resonances, the thermal cross section, the resonance integral and the apparent high density of the low lying levels in niobium, have suggested postulating the existence of negative energy levels or level. These considerations involved the postulated negative energy resonances, and assumptions about positive energy resonances above 50 eV and average unresolved parameters based on nuclear systematics. The experimental technique to obtain a measured integrated cross section in the fast fission spectrum of the Coupled Fast Reactivity Measurements Facility (CFRMF) and the Argonne Fast Source Reactor (AFSR) is investigated with foils of ^{93}Nb containing 4.1% ^{94}Nb utilizing Ge(Li) spectrometry. (auth)

31449 (COO-1265-154, pp 106-109) RELATIVE DIFFERENTIAL CROSS SECTIONS FOR THE REACTION ^{119}Sn(p,n)^{119}Sb (g.s. IAS) FOLLOWED BY PROTON EMISSION. Fitzgerald, D. H.; Lilley, J. S.; Greenlees, G. W.; Woods, T. J. Sep 1974.

In annual report 1974.

31450 (COO-1265-154, pp 110-113) PROTON DECAY OF EXCITED ANALOG STATES FORMED IN ^{119}Sn(p,n)^{119}Sb (IAS). Fitzgerald, D. H.; Lilley, J. S.; Greenlees, G. W.; Woods, T. J. Sep 1974.

In annual report 1974.

31451 (COO-2479-64) PRECISION NEUTRON CROSS SECTION MEASUREMENTS IN SUPPORT OF THE LMFBR PROGRAM. Progress Report for July 1, 1974–September 30, 1974. Block, R. C.; Hockenbury, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). 1974. Contract AT(11-1)-2479. 12p. Dep. NTIS $4.00.

Preliminary reports are given on the subjects of keV neutron capture measurements on ^{143}Nd, ^{149}Sm, ^{101}Ru, ^{102}Ru, and ^{104}Ru and sodium total cross sections at minima. (4 figures, 1 table) (RWR)

31452 (IS-T-654) INTERNAL CONVERSION COEFFICIENTS IN THE DECAY OF ^{91}Kr. Weinbeck, R. S. (Iowa State Univ. of Science and Technology, Ames (USA)). Nov 1974. Contract W-7405-eng-82. 60p. Dep. NTIS $6.00.

Thesis.

The use of a Bartlett-type $\pi\sqrt{2}$ double-focusing beta-ray spectrometer on-line to the TRISTAN isotope separator at Ames Laboratory for measurements of internal conversion coefficients is described. The K-conversion coefficient of the 108.8-keV transition to the ground state in the ^{91}Kr decay was deduced to be 0.109 ± 0.007. The K-conversion coefficient of the 93.6-keV transition to the ground state in the ^{91}Rb decay was determined to be 1.10 ± 0.09. The 93.6-keV K/L ratio was deduced to be 5.95 ± 0.24. These results are related to earlier studies, and conclusions in terms of the shell model are given. (auth)

31453 (LA-UR-75-359) SPALLATION CROSS SECTIONS AND THE LAMPF MEDICAL RADIOISOTOPE PROGRAM. Erdal, B. R.; Grant, P. M.; Casella, V. R.; Ogard, A. E.; O'Brien, H. A. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 5p. (CONF-750303-13). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The intense beam of medium-energy protons (600 to 800 MeV) from the LAMPF accelerator will be used to prepare multi-curie quantities of radioisotopes of value in diagnostic and therapeutic nuclear medicine. Thin-target cross section measurements of spallation-induced reactions represent a significant segment of the LASL Medical Radioisotope Research Program, as these data provide a basis for calculating specific radioisotope yields in thick targets, evaluating potential isotopic interferences, and monitoring hot-cell operations. Recent measurements include the cross sections (cumulative yields) of ^{123}I, ^{127}Xe, ^{82}Sr, and ^{43}K formed in the interaction of 800-MeV protons with La, Mo, and V targets; they are reported to be 51 ± 3 mb, 51 ± 7 mb, 24.5 ± 0.8 mb, and 5.4 ± 0.3 mb, respectively. Comparison with previous results at 590 MeV are made, and quantity and product quality estimates are presented for biomedical isotopes under the irradiation conditions expected to prevail at LAMPF. (3 tables) (auth)

31454 (LBL-3601) SYNTAX-ANALYSIS APPROACH TO DATA RELIABILITY. Litton, G.; Lederer, C. M.; Vardas, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 22 Nov 1974. Contract W-7405-eng-48. 21p. (CONF-750409-1). Dep. NTIS $4.25.

From conference for computing machinery pacific 75; San Francisco, California, USA (17 Apr 1975).

A unique approach was developed to check data for syntax errors—a process that could well be likened to proofreading. The key to the process is the use of a syntax analyzer that was developed primarily for use as a compiler parser and the associated language used to specify syntax. The data checking proceeds in two steps. First, the syntax rules to which the data must conform are written in a syntax-oriented language. They are then fed to a processor which produces a set of tables which are the encoded syntax rules. Second, the data to be checked are fed to a syntax analyzer, which checks it using the encoded syntax rules as a template. The specific data for which this process was developed are those which constitute the Table of Isotopes, published periodically by the Lawrence Berkeley Laboratory. (auth)

31455 (LBL-3614) CURRENT KNOWLEDGE OF THE INTERACTIONS OF RELATIVISTIC HEAVY IONS. Heckman, H. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1974. Contract W-7405-eng-48. 6p. (CONF-741152-1). Dep. NTIS $4.00.

From BeV/nucleon workshop; Bear Mountain, New York, USA (29 Nov 1974).

Some experimental results are reviewed on the nucleus–nucleus interaction in nuclear track emulsions, target fragmentation studies, particle production in heavy-ion collisions, and fragmentation of relativistic carbon-12 and oxygen-16 nuclei. (JFP)

31456 (LF-56) ENERGY SPECTRA OF DELAYED NEUTRONS FROM SEPARATED FISSION PRODUCTS. Part III. The Precursors ^{89}Br, ^{91}Br, ^{93}Rb, ^{139}I, ^{141}(I + Cs) and ^{143}Cs. Rudstam, G.; Shalev, S. (Forskningsraadens Lab., Studsvik (Sweden)). 1974. 28p. Dep. NTIS (US Sales Only) $4.50.

This article is one of a series presenting delayed-neutron energy distributions for mass-separated fission products. Experimental energy spectra were obtained for the delayed neutron precursors ^{89,91}Br, ^{93}Rb, ^{139}I, ^{141}I and ^{143}Cs. Average level spacings, neutron envelopes and P_n values were calculated and compared

with the experimental data. Reasonable agreement was obtained in most cases, although it was necessary to postulate Q_β values of 6.22 and 5.8 MeV for ^{89}Br and ^{91}Br, and 5.84 MeV for ^{139}I. (auth)

31457 (LF-58) BETA-DECAY PROPERTIES OF STRONGLY NEUTRON-RICH NUCLEI. Johansson, K. A.; Nyman, G.; Rudstam, G. (Forskningsraadens Lab., Studsvik (Sweden)). 1974. 43p. Dep. NTIS (US Sales Only) $5.25.

Experimental beta-strength functions for about 50 neutron-rich mass-separated fission products with half-lives between 0.8 s and 30 s have been obtained at the OSIRIS facility. The beta strength to excited states depopulating by delayed-neutron emission is evaluated separately. The β^--strength functions are found to increase strongly with excitation energy, which is in contrast to the approximately energy-independent beta strength found for EC decay. By using semiempirical values for the level density, the average transition rate per energy interval was evaluated under the assumption that only allowed and first-forbidden transitions contribute to the decay. This alternative way of analyzing the data gives a more uniform picture of the beta decay to highly excited states since the transition rates are found to be roughly independent of excitation energy (above the pairing energy). A constant model-transition rate is introduced and its systematic behavior is studied. Its use for estimating half-lives of unmeasured nuclides is demonstrated. Estimates of this kind are valuable for calculations on nucleosynthesis by the "r-process". (auth)

31458 (ORO-3924-19) ANGULAR MOMENTUM EFFECTS IN NUCLEAR REACTIONS. Progress Report, January 1, 1974–December 31, 1974. Natowitz, J. B. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). 1974. Contract AT(40-1)-3924. 47p. Dep. NTIS $5.50.

A summary is presented of research performed under AEC contract No. AT-(40-1)-3924 during the period 1 January 1974 to 31 December 1974. Fusion cross section measurements were made for the reaction of 157 and 262 MeV ^{14}N projectiles with Al, Cr and Ni target nuclei. At the higher energy cross sections for production of heavy recoiling evaporation residues indicate the production of Ca, Ga and Br nuclei with angular momenta which equal or exceed the calculated liquid drop limits. The saturation limit predicted by the Bass dynamic model is also exceeded in the ^{14}N + Al reaction. Fission and fission-like processes in the reactions of 197 MeV ^{12}C ions with Ni, Y, Mo, Ag, Sn, and Au targets are being investigated with emphasis on studies of the nature of fission in the medium mass region. The calibration of a detector system to be utilized for in-beam studies of continuum γ-ray emission in heavy ion induced reactions is described. The status of a collaborative study of fragment emission in reactions induced by 800 MeV protons is summarized. Separate abstracts are prepared for two sections of this report. (auth)

For abstracts of individual sections see: 31387 and 31459.

31459 (ORO-3924-19, pp 6-8) FISSION AND FISSION-LIKE PROCESSES. Natowitz, J. B.; Namboodiri, M. N.; Chulick, E. T.; Geoffroy, K. 1974.

In angular momentum effects in nuclear reactions. Progress report, January 1, 1974–December 31, 1974.

Studies of the fission of the medium mass elements was initiated in order to test theoretical predictions of the effect of the Businaro–Gallone limit, the point at which the nucleus becomes unstable towards asymmetric distortions. As a consequence of this instability the mass distribution of fission products is expected to become very broad. The heavy nuclei produced in the reactions of 197-MeV carbon-12 projectiles with Y, ^{98}Mo, Ag, and Sn targets were observed. The differential cross sections were plotted. Energy spectra are also discussed. (JFP)

31460 (USIP-74-17) TRANSITION RATES IN ^{88}Y, ^{90}Y, AND ^{92}Nb. Brenner, M.; Forssten, K.; Ishihara, M.; Monseu, P.; Nilsson, A. (Stockholm Univ. (Sweden). Fysiska Institutionen). May 1974. 39p. Dep. NTIS (US Sales Only) $5.00.

A number of transition rates in the odd–odd nuclei ^{88}Y, ^{90}Y and ^{92}Nb were measured using Doppler-shift techniques. The results were compared to theoretical estimates based on g-factors of neighboring nuclei. In some cases information was obtained on the configuration admixtures of the levels. Supporting evidence for level assignments of ^{88}Y was obtained by the standard methods of in-beam γ-ray spectroscopy. (auth)

31461 (WANL-TME-698) NIOBIUM RESONANCE PARAMETERS AND RESONANCE INTEGRAL. Melnick, M. M.; Drawbaugh, D. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 6 Mar 1964. 15p. Dep. NTIS $4.00.

The resonance integral is calculated by determining the contributions from the resolved and unresolved resonances and summing. Calculated values of the Nb resonance integral are compared with measurements. Recommended values for reactor calculations are discussed. An appendix describes the analysis of Nb levels, including average level spacing, strength function, distribution of scattering widths, and "repulsion of levels". (5 figures, 2 tables) (RWR)

31462 LIFETIMES OF EXCITED STATES OF ^{99}Ru AND ^{101}Ru. Erohkina, K. I.; Lemberg, I. Kh.; Mishin, A. S.; Pasternak, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1673-1678(Aug 1974). (In Russian).

The Doppler-shift attenuation of the energy of the γ lines emitted as a result of the Coulomb excitation of ^{99}Ru and ^{101}Ru was studied. Data on the lifetimes of seven excited states were obtained. (2 figures, 1 table) (tr-auth)

31463 MEASUREMENT OF THE LIFETIMES OF EXCITED STATES OF ^{105}Pd, ^{107}Ag, ^{109}Ag, ^{117}Sn, ^{125}Te, ^{127}I, AND ^{133}Cs. Erokhina, K. I.; Zhirgulevichyus, R. K.; Lemberg, I. Kh.; Pasternak, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1679-1684(Aug 1974). (In Russian).

As a result of the study of the Doppler-shift attenuation of the energy of γ lines emitted during Coulomb excitation, the lifetimes of 14 excited states were measured. The values obtained are tabulated. (1 table) (tr-auth)

31464 NEW ISOTOPE OF TELLURIUM: ^{113}Te. Burminskii, V. P.; Kiselev, B. G.; Kovrigin, O. D. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 1566-1568(Aug 1974). (In Russian).

Foils enriched 64% in ^{112}Sn were irradiated with α particles at 35 to 50 MeV. ^{113}Te was obtained with a measured half-life of 68 ± 15 s. The energies and relative intensities of some γ lines were determined. (3 figures, 1 table) (JSR)

31465 NEW INDIUM ISOTOPE: ^{105}In. Burminskii, V. P.; Kovrigin, O. D.; Nezgovorova, Z. V.; Sychikov, G. I. (Inst. of Nuclear Physics, Kazan). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1562-1565(Aug 1974). (In Russian).

Metallic foils enriched in ^{106}Cd, ^{108}Cd, and ^{107}Ag were irradiated with 30-MeV protons and 51-MeV ^{3}He ions. γ lines at 130.8 ± 0.4, 195, 257, 669, and 833 keV were detected and assigned to ^{105}In. The half life of ^{105}In was measured as 5.1 ± 0.3 min. The relative intensities of the γ lines are reported. (3 figures, 1 table) (JSR)

31466 DECAY OF ^{95}Rh TO LEVELS OF ^{95}Ru. Weiffenback, C.; Gujrathi, S. C.; Lee, J. K. P. (McGill Univ., Montreal). Can. J. Phys.; 53: No. 2, 101-106(15 Jan 1975).

The decay of ^{95}Rh^g ($T_{½}$ = 5.02 ± 0.10 min) and ^{95}Rh^m ($T_{½}$ = 1.96 ± 0.04 min) were studied using Ge(Li) detectors and a plastic β detector. A 543.3 ± 0.3 keV isomeric transition was identified. Gamma–gamma and gamma–beta coincidence experiments were performed. From the β endpoint energy measurement, the mass excess of ^{95}Rh was determined to be −78.34 ± 0.15 MeV. Decay schemes for the ^{95}Rh^{g,m} are proposed. (auth)

31467 GAMMA-RAY DOPPLER SHIFT MEASUREMENTS IN ^{93}Mo. Charvet, A.; Chery, R.; Duffait, R.; Morgue, M. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 238: No. 2, 333-339(3 Feb 1975).

The lifetimes of a number of levels in ^{93}Mo have been measured with the Doppler shift attenuation method (DSAM) using the ^{93}Nb(p, nγ)^{93}Mo reaction and observing the γ-rays emitted by the ^{93}Mo nuclei recoiling in the self-supporting ^{93}Nb target. The lifetimes are: 115^{+40}_{-25}fs, 1362.95 keV; 340^{+180}_{-85}fs, 1477.15 keV; 38^{+20}_{-15}fs, 1492.30 fs; >280 fs, 1520.28 keV; 95^{+30}_{-25}fs, 1694.50 keV; 205^{+100}_{-65}fs, 2141.10 keV; >390 fs, 2246.80 keV; >290 fs, 2303.90 keV; >500 fs, 2355.25 keV; >900 fs, 2409.00 keV; 160^{+80}_{-50}fs, 2430.90 keV; >440 fs, 2440.20 keV; 87^{+40}_{-30}fs, 2479.00 keV; 130^{+80}_{-50}fs, 2535.20 keV. The results are compared to previous experimental or theoretical investigations. (auth)

31468 A STUDY OF THE ^{140}Ce(d,p) AND ^{142}Nd(d,p) REACTIONS AT 19 MeV. Booth, W.; Wilson, S.; Ipson, S. S. (Bradford Univ. (UK)). Nucl. Phys., A; 238: No. 2, 301-324(3 Feb 1975).

The ^{140}Ce(d,p) and ^{142}Nd(d,p) reactions have been studied at an incident deuteron energy of 19 MeV using the injector-tandem accelerator and the multichannel magnetic spectrograph of the University of Oxford. Deuteron optical-model parameters have been obtained from the analyses of elastic scattering experiments on enriched ^{140}Ce and ^{142}Nd targets. The parameters have been used to calculate theoretical (d,p) angular distributions on the basis of the DWBA. Orbital angular momentum transfers have been deduced and spectroscopic factors have been determined for almost all the levels observed up to an excitation energy of 3.5 MeV in ^{141}Ce and ^{143}Nd. The spectroscopic information is more complete than that derived from previous studies, and agrees

satisfactorily with expected sum-rule limits. Unified-model calculations have been made of odd-parity states and very good agreement with the experimental spectra of nuclei having N = 83 has been found. (auth)

31469 REVISED SINGLE-PARTICLE ENERGIES IN N = 83 NUCLEI. Kleinheinz, P. (California Univ., Berkeley (USA)); Maier, M. R.; Diamond, R. M.; Stephens, F. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Sheline, R. K. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Phys. Lett., B; 53: No. 5, 442-444(6 Jan 1975).

Half-life measurements show that the lowest high-j state in ^{141}Ce, ^{143}Nd, ^{145}Sm, and ^{147}Gd, earlier assigned as an $h_{\frac{9}{2}}$ fragment, is an $i_{\frac{13}{2}}$ single-neutron excitation which previously was thought to lie above 3 MeV in the N = 83 nuclei. (auth)

31470 GAMMA-RAY COMPETITION WITH NEUTRON EMISSION IN THE DECAY OF ^{137}I. Nuh, F. M.; Slaughter, D. R.; Prussin, S. G. (California Univ., Berkeley (USA). Dept. of Nuclear Engineering); Kratz, K. L.; Franz, H.; Herrmann, G. (Mainz Univ. (F. R. Germany). Inst. fuer Anorganische Chemie und Kernchemie). Phys. Lett., B; 53: No. 5, 435-438(6 Jan 1975).

Gamma-rays with energies above the neutron binding energy in ^{137}Xe have been observed at 3907 and 3994 keV in the decay of ^{137}I. Their combined intensity amounts to about 25% of the delayed neutron intensity and demonstrates that γ-ray widths are an important factor in defining the magnitude and energy distribution of the delayed neutron spectrum. (auth)

31471 DECAY OF 59.3 MIN ^{128}Sn TO LEVELS OF ^{128}Sb. Imanishi, N.; Fujiwara, I.; Nishi, T. (Kyoto Univ., Uji (Japan). Inst. of Atomic Energy). Nucl. Phys., A; 238: No. 2, 325-332 (3 Feb 1975).

The γ-ray spectra associated with the decay of 59.3 min ^{128}Sn have been measured with Ge(Li) detectors. In order to recognize γ-rays of ^{128m}Sb, the decay and/or growth of γ-rays emitted from a tin sample separated chemically from fission products were measured. The decay of ^{128}Sn is followed by the intense Sb X-rays and 32.1, 45.8, 75.1, 80.9, 115.9, 152.6, 404.4, 482.3, 557.3 and 680.2 keV γ-rays. On the basis of the measured singles and $\gamma-\gamma$ coincidence spectra and the analysis of intensities of true sum peaks, a new decay scheme has been constructed. The 10.0 min isomer in ^{128}Sb decays by β-emission (96.4%) to excited levels in ^{128}Te and by an isomeric transition (3.6%) to the 9.1 h ground state. (auth)

31472 LEVELS OF ^{93}Rb AND ^{93}Sr POPULATED IN THE β DECAYS OF ^{93}Kr AND ^{93}Rb. Brissot, R.; Schussler, F.; Monnand, E.; Moussa, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). Nucl. Phys., A; 238: No. 1, 149-158(27 Jan 1975). (In French).

The beta and gamma activity of ^{93}Kr and its daughter, ^{93}Rb, produced in the fission of ^{235}U, have been studied by using the ARIEL on-line isotope separator. The Q_β values have been measured to be 7300 ± 200 keV for the decay of ^{93}Kr and 5750 ± 100 keV for ^{93}Rb. The ground-state β-feeding in the first case is 5% and in the second case, 42%. By using $\gamma-\gamma$ coincidences, nearly 90% of the total γ activity could be placed in both cases. Seventeen levels were determined in $^{93}_{37}Rb_{56}$ and 25, in $^{93}_{38}Sr_{55}$. Spin assignments are proposed for the ground states and for some specific levels. (auth)

31473 NUCLEI FAR FROM STABILITY. Hansen, P. G. (European Organization for Nuclear Research, Geneva (Switzerland)). v.2 p.662-695 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Examples of recent results in the study of neutron-deficient or neutron-rich nuclei of medium to heavy mass are given. The exotic decay modes associated with the unusual energies away from stability, high-energy beta decay and beta-delayed particle emission are reviewed; and it is shown how an over-all picture of these phenomena, combining a pronounced gross structure with statistical features, is now emerging. New developments in the study of alpha and beta transition rates and the properties of nuclear states in selected regions of the nuclear chart are described. Some new experimental techniques, with their important implications for future work, are briefly discussed. (auth)

31474 GAMMA RAY ANGULAR DISTRIBUTION AND POLARIZATION MEASUREMENTS. Twin, P. J. (Liverpool Univ. (UK)). v.2 p.536-553 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The following specific topics in nuclear structure experiments are discussed: 1) the existence of inherent ambiguities, which occur when the primary γ-ray angular distribution can be fitted with more than one set of J_i^π, δ_i; 2) the resolution of ambiguities by measuring further γ-ray angular correlations, including suggestions of useful geometries for $\gamma-\gamma$ correlations; and 3) the resolution of ambiguities by measuring the polarization of the primary γ-ray, including a brief survey of recent Compton polarimeters. (auth)

31475 NUCLEAR MAGNETIC RESONANCE ON ORIENTED ^{90}Nb IN Fe. Hagn, E.; Kienle, P. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.); Eska, G. (Zentralinstitut fuer Tieftemperaturforschung, Garching, F. R. Germany). v.2 p.576-579 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The knowledge of magnetic moments of nuclear states in the vicinity of closed shells is interesting in order (1) to study the influence of mesonic effects ($\delta g_1 \sim 0.1\ \tau_3$) and (2) to test the additivity of the magnetic moments. In the region A ~ 90 δg_1 = 0.10 ± 0.03 has been reported for proton states. To get further information the nuclear g-factor of the ground state of ^{90}Nb ($J^\Pi = 8^+$; $T_{\frac{1}{2}}$ = 14.6 h was measured. This state has the shell model configuration $(\Pi g_{\frac{9}{2}}; \nu g_{\frac{7}{2}}^{-1})$ where $^{88}_{40}Zr_{50}$ is assumed to be the core. (auth)

31476 RECENT DEVELOPMENTS IN THE STUDY OF ELECTRIC QUADRUPOLE MOMENTS. Herskind, B.; Neiman, M. (Niels Bohr Institutet, Copenhagen (Denmark)). v.2 p.599-617 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The nuclear quadrupole moment is an important nuclear parameter, expressing the deviation from spherical symmetry of the nuclear charge distributions, and thus directly related to the nuclear shape. A critical view is given on the reorientation technique as well as the newly developed reorientation precession technique, both of which are applicable to nuclear states in the subnanosecond region. A recently developed method based on differential perturbed angular correlations is also mentioned. (auth)

31477 NUCLEAR LIFETIMES. Warburton, E. K. (Brookhaven National Lab., Upton, N. Y. (USA)). v.2 p.506-531 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The measurement of the lifetimes of bound nuclear levels is discussed. The related subjects of direct timing by pulsed beams and the associated particle techniques are discussed very briefly, and the activity going on in Doppler shift measurements is described, including the problem of stopping power uncertainties. Recent technical advances in the recoil distance method, Coulomb excitation and the new field of shape isomers in fission are described. (NL)

31478 EXCITATION OF DEEPLY BOUND HOLE STATES IN TIN. van der Werf, S. Y.; Kooistra, B. R.; Fryszczyn, B.; Hesselink, W. H. A.; Iachello, F.; Put, L. W.; Siemssen, R. H. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versneller Instituut). v.2 p.416-419 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Excitation of deeply bound hole states via the (p,d) reaction on several medium mass and heavy nuclei was recently reported by Sakai and by Ishimatsu. To supply independent evidence for their observation with an alternative process, the (d,t) reaction at E_d = 50 MeV is studied on the even-A isotopes of tin (with the

exception of ^{116}Sn). In all the spectra a broad, giant-resonance-like peak is seen around 5 MeV excitation energy. The peak appears to be narrowest for ^{115,117}Sn and seems to broaden both towards smaller and larger neutron number, though the results for ^{112}Sn are less certain because of possible contaminants. Superimposed on the gross structure some narrower width structure is seen. (auth)

31479 BACKBENDING AND DECOUPLING IN ^{126}Ba. Flaum, C.; Cline, D. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.); Sunyar, A. W.; Kistner, O. C. (Brookhaven National Lab., Upton, N. Y. (USA)); Lee, Y. K.; Kim, J. S. (Johns Hopkins Univ., Baltimore, Md. (USA)). v.2 p.242-244 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The anomalous behavior of the moment of inertia of ground-state rotational bands, sometimes called "backbending," has been extensively investigated. The superfluid phase transition picture of Mottelson and Valatin and the two-quasi-particle band-crossing picture of Stephens and Simon are the two major physical models capable of accounting for the observed behavior. This work is an experimental and theoretical investigation of this behavior in ^{126}Ba with the hope that the relative importance of the two models may be clarified. High-spin states in ^{126}Ba were excited via the ^{114}Cd(^{16}O,4n) reaction by using an 83-MeV ^{16}O beam from the Brookhaven National Laboratory dual tandem Van de Graaff facility. Angular distributions, coincidences and linear polarization of the deexcitation gamma rays were studied by using large Ge(Li) spectrometers. (auth)

31480 NEW ISOTOPE OF PRASEODYMIUM: ^{132}Pr($T_{\frac{1}{2}}$ = 1.6 ± 0.3 min). Arlt, R. (Technical Univ., Dresden); Gromov, K. Ya.; Latuszynski, A.; Ortlepp, H. G.; Jasinski, A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1569-1571(Aug 1974). (In Russian).

After the irradiation of Ta foils with 660-MeV protons the ^{132}Pr isotope was detected. During its decay the following γ lines with the relative intensities in parentheses were observed: 325.2 keV (100), 496.1 keV (23), and 533.1 keV (19). (JSR)

31481 STUDY ON NUCLEI AWAY FROM STABILITY VALLEY FOR BETA DECAY. Hansen, P. G. (European Organization for Nuclear Research, Geneva (Switzerland)). J. Phys. (Paris), Colloq.; No. 5, 29-36(1974). (In French).

From symposium on nuclear physics with cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

Recent results in the study of nuclei away from beta stability are reviewed with partfcular emphasis on on-line mass separation experiments involving heavy nuclei. As examples, nuclear masses, the structure on the light mercury isotopes, the doubly magic region of ^{132}Sn, and the beta strength function and delayed-particle emission are discussed. (FR)

31482 HIGH SPIN STATES IN ODD-MASS DEFORMED NUCLEI. Gizon, A. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). J. Phys. (Paris), Colloq.; No. 5, 21-28 (1974). (In French).

From symposiun on nuclear physics with cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

Rotation-particle coupling in odd-mass deformed nuclei with extension to small deformations (Stephens' Model) is discussed. Some experimental data obtained with (H I, xny) reactions, where high spin levels give evidence on the deformation of the nuclei, are analyzed. (FR)

31483 HIGH-SPIN STATES IN DEFORMED EVEN–EVEN NUCLEI. Vervier, J. (Institut de Physique Corpusculaire, Louvain-la-Neuve (Belgium)). J. Phys. (Paris), Colloq.; No. 5, 13-20(1974). (In French).

From symposiun on nuclear physics with cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

High-spin states in the rotational bands of deformed even–even nuclei frequently display the backbending phenomenon, i.e., a sudden increase of the moment of inertia at high angular momenta. The models proposed for explaining these results are reviewed and compared with experimental data on various nuclei in the rare-earths region; no definite conclusions can be drawn from this comparison in favor of one or another of these theories. The experimental results on the nuclei ^{154}Gd and ^{156}Dy can be interpreted as arising from the interaction between 3 bands: the ground-state and β-vibrational bands and a third band whose nature remains to be determined. (FR)

31484 SPECTROSCOPIC INTEREST OF TWO NUCLEAR TRANSFER REACTIONS INDUCED BY LIGHT IONS. Seltz, R. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. des Basses Energies). J. Phys. (Paris), Colloq.; No. 5, 67-74(1974). (In French).

From symposium on nuclear physics with cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

The various aspects of the experimental investigation of two nucleon transfer reactions with light particles are summarized: spectroscopy of exotic nuclei, isospin mixing in light and medium nuclei, the (d,α) reaction for the study of the f($^7/_2$) shell proton pairing around A = 56, collective properties of even–even nuclei, shape transition and core excitation in odd-Z nuclei. Views on future experimental and theoretical development of the nucleon transfer reaction are pointed out. (FR)

31485 INTERACTIONS BETWEEN VERY HEAVY IONS. Colombani, P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). J. Phys. (Paris), Colloq.; No. 5, 75-83 (1974). (In French).

From symposium on nuclear physics with cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

Some features of interactions between very heavy ions (A> = 40) at high energy (5–10 MeV/nucleon) are presented: elastic and inelastic scattering, Coulomb excitation, multinucleon transfers. The importance of surface phenomena is pointed out and is discussed in the semiclassical theory framework; some consequences on the compound nucleus formation are also indicated. (FR)

31486 GIANT RESONANCES. Bergere, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique Nucleaire). J. Phys. (Paris), Colloq.; No. 5, 53-60(1974). (In French).

From symposium on nuclear physics with cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

Recently a number of experimental data about the high energy collective modes in nuclei (giant resonances) have been published. The observed energies for these giant resonances agree with those proposed in Bohr-Mottelson's hydrodynamic classification. These experimental data are summarized according to the method used to excite the giant resonances: by absorption of real photons, by radiative capture of protons and alphas, by inelastic scattering of hadrons, by virtual excitation of nuclei, by inelastic scattering of electrons and by capture of μ^- and π^- mesons. (FR)

31487 PROSPECTS IN HEAVY IONS NUCLEAR PHYSICS. Lefort, M. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). J. Phys. (Paris), Colloq.; No. 5, 37-52 (1974). (In French).

From symposium on nuclear physics with cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

A short survey is given on the status of heavy ion accelerators in 1974, followed by a presentation of the most elaborate project. The problem of beam degradation by the targets is analyzed. Multiple scattering and angular scattering are the main difficulties. The status of the current research on heavy ion physics is given as well as the possible extension in the future, for the following topics: elastic scattering nuclear shapes, Coulomb excitation, high spin levels, quasi-elastic transfer reactions, correlated-nucleon structure, deep inelastic transfer reactions, complete fusion and incomplete fusion. It is shown that a great variety of projectiles as well as a wide energy range are needed with an energy resolution as good as 100 keV for most of the fields. Long-dated prospects are more difficult to give. Three new fields are tentatively defined: 1) Extension of the range of known nuclei highly deficient in neutrons, rich in neutrons and superheavy nuclei. 2) Development of nuclear macrophysics which will be favored by heavy projectiles and velocities greater than sound velocity. 3) Complex excitation spectroscopy for exotic nuclear states. The need for energy as high as 100 MeV/A is again emphasized. (FR)

31488 SYSTEMATICAL EFFECTS OF NUCLEAR DEFORMATIONS ON NEUTRON-NUCLEUS TOTAL CROSS SECTIONS. Lagrange, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). J. Phys. (Paris), Lett.; 35: No. 9, L-III–L-115(Sep 1974). (In French).

The effects of nuclear deformations on the total neutron cross section for the energy range 2 MeV < = E_n < = 20 MeV are calculated for the nuclei: ^{238}U, ^{182}W, ^{154}Sm, ^{152}Sm, ^{150}Sm, ^{148}Sm. Analysis of theoretical results from coupled channel calculations has established the oscillatory dependence of these effects on E_n. In the energy regions where these effects are significant, the calculations are in excellent agreement with the structure of the differences recently measured between the cross sections of various samarium isotopes. (FR)

31489 ON THE DECAY OF ^{133}Ba TO ^{133}Cs. Awwad, Z.; Ibrahim, N. M.; El-Aasser, M. R. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Nuclear Physics). Atomkernenergie; 24: No. 2, 129-132(1974).

The decay of ^{133}Ba to ^{133}Cs was re-investigated by the high precision iron-yoke and the 50 cm iron-free, double focusing spectrometers. The relative electron intensities were measured, the internal conversion coefficients, electron capture ratios, and the log ft values were calculated. The results show a good agreement with previous work. It was found, also, that the 160.42- and the 223.18-keV transitions are pure M1. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 31316, 31349, 31355, 31375, 31434, 31440, 31446, 31480, 31481, 31483, 31488, 31512, 31527, 31541, 31578, and 31589.

31490 (BNL-18882) RECENT DEVELOPMENTS IN NEUTRON CAPTURE γ-RAY SPECTROSCOPY. Chrien, R. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 23p. (CONF-740495-1). Dep. NTIS $4.25.

From Japanese Physical Society meeting; Osaka, Japan (3 Apr 1974).

Recent experiments are described to illustrate the use of the (n,γ) reaction to study the reaction mechanism in the framework of the R-matrix theory of Wigner and Eisenbud. The experimental technique is illustrated with examples from capture into ^{163}Dy and ^{164}Dy. The results indicate that the (n,γ) reaction may be a new tool sensitive to the phases and amplitudes of the low-lying states in deformed nuclei. Then the internal part of the collision matrix is examined. The "valence" model is discussed with reference to ^{92,94,96,98}Mo. The observed strength is far larger than would be predicted from either statistical, valence, or giant resonance extrapolation predictions. The experimental evidence suggests strongly that, while nonstatistical effects (correlations) are evident in the Mo region, the explanation cannot lie in the valence model. It is concluded that radiative transition probabilities on resonances behave in a largely statistical manner for A > 100. The off-resonance intensities, after correction for local level contributions, are proportional to the single-particle content of the final state. (14 figures, 3 tables) (RWR)

31491 (CEA-CONF-2853) EFFECTS OF NUCLEAR DEFORMATIONS ON NEUTRON TOTAL CROSS SECTIONS. Lagrange, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1973. 8p. (CONF-740320-8). Dep. NTIS (US Sales Only) $4.00.

From EANDC topical meeting; Tokyo, Japan (27 Mar 1974).

The study presented is to determine to what degree systematic effects of nuclear deformations could be represented within the framework of coupled-channel calculations. The coupled channel code JUPITOR 1 of TAMURA was modified and used for these tests. (auth)

31492 (COO-1265-154, pp 114-115) ^{150}Sm(^{3}He,d)^{151}Eu REACTION AND COEXISTENCE OF SPHERICAL AND DEFORMED STATES. Sharma, H.; Taketani, H.; Hintz, N. Sep 1974.

In annual report 1974.

31493 (COO-1265-154, pp 128-131) ELASTIC AND INELASTIC SCATTERING OF ^{16}O ON ^{152}Sm. Weber, D.; Sharma, H.; Shkolnik, V.; Artz, J. L.; Dehnhard, D.; Hintz, N. M. Sep 1974.

In annual report 1974.

31494 (COO-3255-7) LEVELS IN ^{153}Dy AS POPULATED FROM DECAY OF ^{153}Ho IN EQUILIBRIUM WITH 2.3-h ^{153}Er. Ruth, T. J.; Brenner, D. S. (Clark Univ., Worcester, Mass. (USA). Jeppson Lab. of Chemistry). 1974. 48p. Dep. NTIS $5.50.

The γ-ray spectrum of the decay of ^{153}Ho in transient equilibrium with 2.3-h ^{153}Er was studied with Ge(Li) detectors. Results of γ-ray singles and coincidence experiments are reported, and a decay scheme for ^{153}Ho → ^{153}Dy is proposed. New levels were assigned to the β-vibrational band and a rotational band built on the two-quasi-neutron state (ν 5/2$^-$ [523] + ν 3/2$^-$ [521]). A new K = 2 rotational band with spins up to 6$^+$ built on a level at 1851.9 keV is proposed. An attempt is made to characterize a group of negative-parity states at about 1400 keV, and tentative assignments of the K = 0, 1, and 2 octupole vibrational band heads are suggested. (7 figures, 7 tables) (auth)

31495 (JINR-E6-8363) ANGULAR CORRELATION MEASUREMENTS IN ^{165}Er. Fuia, H.; Ion-Mihai, R.; Morozov, V. A.; Muminov, T. M.; Budzynski, M.; Holbaev, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

Gamma-gamma angular correlation measurements have been performed to determine the spins for some excited levels and the mixing parameters Q for several gamma transitions in ^{165}Er. The obtained spin values are 1/2 and 3/2 for 589.7- and 1427.1-keV levels, respectively. (1 figure, 2 tables) (auth)

31496 (JINR-E6-8516) NEW ^{157}Tm ISOTOPE, $T_{1/2}$ = (3.6 ± 0.3) MIN. Latuszynski, A.; Mikulski, J.; Penev, I.; Potempa, A. W.; Zielinski, A.; Zuber, K.; Zuber, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 16p. Dep. NTIS (US Sales Only) $4.00.

The new isotope ^{157}Tm was discovered, and its half-life $T_{1/2}$ = (3.6 ± 0.3) min was measured. On the basis of the balance of energies and intensities of γ-transitions occurring in the ^{157}Tm decay a number of excited states of the ^{157}Er nucleus with energies of 110.2; 241.3; 357.3 and 457.1 keV were found. (auth)

31497 (JINR-P3-8511) NEUTRON RESONANCE SPINS FOR ^{167}Er AND ^{173}Yb. Karzhavina, E. N.; Kim Sek Su; Popov, A. B.; Faikov, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Neutron resonance spins for ^{167}Er and ^{173}Yb were measured by the gamma-quantum multiplicity method by using the neutron spectrometer (Laboratory of Neutron Physics, JINR) with the resolution of 16 ns/m. The spins for 60 resonances of ^{167}Er in the region to 280 eV and for 56 resonances of ^{173}Yb in the region to 600 eV were measured. Analyzing contemporary data for even-odd isotopes of rare earth nuclei, the authors concluded that there is no spin effect in strength functions of this nuclear region. (2 figures, 3 tables) (auth)

31498 (JINR-P6-8523) DECAY OF ^{156}Ho. Gromov, K. Ya.; Zhelev, Zh. T.; Zuber, K.; Zuber, Ya.; Islamov, T. A.; Kuznetsov, V. V.; Ortlepp, H.-G.; Potempa, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 26p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The γ-ray, internal conversion electron, γ-γ- and β$^+$-γ-coincidence spectra are measured. The excited levels of ^{156}Dy and the ground state spin and parity ^{156}Ho are suggested. (auth)

31499 (JINR-P7-8567) LIFETIMES OF HIGH SPIN ROTATIONAL STATES OF ^{164}Yb MEASURED BY DOPPLER-SHIFT RECOIL-DISTANCE METHOD. Bochev, B.; Iliev, S.; Kalpakchieva, R.; Karamyan, S. A.; Kutsarova, T. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The lifetimes and the side-feeding times of the high spin ground-band levels of ^{164}Yb were measured by a recoil-distance Doppler-shift method following (^{40}Ar, 4n) reaction. Only a small retardation of the transitions in the back-bending region is found. The experimental B(E2) values are compared with theoretical predictions. (auth))

31500 (USIP-74-08) PROGRAM MULPAC FOR THE ANALYSIS OF DATA FROM PERTURBED ANGULAR CORRELATION AND MULTIPLE LIFETIME EXPERIMENTS. Bargholtz, C. (Stockholm Univ. (Sweden). Fysiska Institutionen). Apr 1974. 51p. Dep. NTIS (US Sales Only) $5.75.

A method for the analysis of data from perturbed angular correlation, or distribution, experiments is described. The method allows for the presence of a prompt contribution, and it is suited for the analysis of lifetime data involving up to three different decay constants. A computer code based on this method is described, and the result of extensive tests is presented. (auth)

31501 (USIP-74-21) HIGH-SPIN LEVELS IN ^{155}Dy FROM THE ^{154}Gd(α,xnγ)^{155}Dy REACTION AND SOME PROPERTIES OF ROTATIONAL EXCITATIONS IN ODD-MASS Dy ISOTOPES. Hjort, S. A.; Klamra, W. (Stockholm Univ. (Sweden). Fysiska Institutionen). Sep 1974. 40p. Dep. NTIS (US Sales Only) $5.00.

Information on high-spin rotational states in ^{155}Dy has been obtained by observing the γ-rays emitted when a ^{154}Gd target is bombarded with 31-43 MeV α-particles. These data are discussed together with previously available data on ^{157}Dy, ^{159}Dy and ^{161}Dy within a model where a particle is coupled to a rotor with a variable moment of inertia. There is often a definite improvement in the quality and stability of the fits to levels in the positive-parity band below spin 25/2 when the moment of inertia of the core exhibits a linear dependence on the square of the rotational angular velocity as compared to the situation where a linear dependence on I(I + 1) is assumed. In the improved fits the empirical matrix elements of the Coriolis force exhibit a smooth

and significant increase with decreasing moment of inertia. The rotational energies above spin 25/2 in the positive-parity band and above 19/2 in the $11/2^-$ [505] band are understood within the present theoretical model if the moment of inertia increases more rapidly than the linear trend established at lower spin. In the $11/2^-$ [505] band this increase follows rather closely the behavior in the even nuclei, whereas in the positive-parity band the curves are quite flat even beyond the point where the moment of inertia in the even nuclei exhibits a discontinuous or back-bending behavior. The significance of this observation is discussed in the light of existing theories of the moment of inertia. The data for the $3/2^-$ band, which occurs as a ground state in ^{155}Dy, ^{157}Dy, and ^{159}Dy, are understood if the intrinsic structure changes from being predominantly $1h_{\frac{9}{2}}$ in ^{157}Dy and ^{159}Dy to being mainly of a $2f_{\frac{5}{2}}$ character in ^{155}Dy. (auth)

31502 DECAY OF THE NEW RHENIUM ISOTOPES ^{170}Re AND ^{172}Re. Berlovich, E. E.; Vaishnis, P. P.; Vitman, V. D.; Ignatenko, E. I.; Moroz, F. V.; Panteleev, V. N.; Tarasov, V. K. (Inst. of Nuclear Physics, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1577-1579(Aug 1974). (In Russian).

Two new short-lived neutron-deficient isotopes of Re were observed: ^{172}Re with $T_{\frac{1}{2}} = 30 \pm 5$ s and ^{170}Re with $T_{\frac{1}{2}} = 9 \pm 2$ s. The energies and relative intensities of the γ lines observed were reported. The $\gamma-\gamma$ coincidences were measured. The characteristics of the β decay of ^{172}Re with population of the levels of the ground-state rotational band of ^{172}W up to spin 8^+ were examined. A scheme for the low-lying levels of ^{170}W excited during the β decay of ^{170}Re was proposed. (2 figures, 2 tables) (tr-auth)

31503 EFFECT OF MIXING THE 2133.0- AND 2160.3-keV 3^+ LEVELS OF ^{166}Er. Artamonova, K. P.; Grigor'ev, E. P.; Gromov, K. Ya.; Zolotavin, A. V.; Kamynov, Sh. V.; Sergeev, V. O. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1763-1771(Aug 1974). (In Russian).

The internal conversion electron and γ spectra arising during electron capture in ^{166}Tm were studied. It was shown that the ratios of the reduced probabilities of M1 and E2 transitions from the 2133- and 2160-keV levels of ^{166}Er can be explained by the effects of mixing the components with K = 2 and K = 3 in the wave functions of both states. (2 figures, 2 tables) (tr-auth)

31504 STRUCTURE OF THE GROUND STATES OF ^{174}Re, ^{176}Re, AND ^{178}Re. Berlovich, E. E.; Vaishnis, P. P.; Vitman, V. D. (Inst. of Nuclear Physics, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1705-1710(Aug 1974). (In Russian).

It was shown that the characteristics of the β decay of ^{174}Re, ^{176}Re, and ^{178}Re can be explained if it is assumed that the I = 3 rotational level of the rotational band with K = 1 is the ground state. It was shown that the conditions under which the I = 3 level can be lowered below the levels with I = 2 and 1 can be fulfilled for the configuration $p^{\frac{1}{2}}[541]\uparrow n^{\frac{1}{2}}[521]\uparrow$, and this configuration can be realized with great probability in ^{176}Re, ^{176}Re, ^{174}Re, and ^{174}Ta. (1 figure) (tr-auth)

31505 ALPHA DECAY OF NATURAL ^{186}Os. Viola, V. E.; Roche, C. T.; Minor, M. M. (Univ. of Maryland, College Park). J. Inorg. Nucl. Chem.; 37: No. 1, 11-13(Jan 1975).

An isotopically enriched sample of natural ^{186}Os was studied in order to demonstrate the presence of radioactive alpha decay in this nuclide. The measured half-life is found to be $(2.0 \pm 1.1) \times 10^{15}$ yr, in good agreement with semi-empirical predictions. (auth)

31506 EXCITATION AND DECAY OF HIGH-SPIN STATES. Lieder, R. M. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). v.2 p.212-241 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Experimental results obtained for high-spin states in deformed nuclei in the rare earth region and for the adjacent transitional nuclei are discussed. The study of high-spin states in these nuclei has yielded new and unexpected information about their nuclear structure, such as the observation of the (1) backbending effect, (2) rotation-aligned bands, (3) spherical–deformed shape transitions. (auth)

31507 MAGNETIC MOMENTS OF HIGH-SPIN STATES ABOVE THE ROTATIONAL BAND OF ^{168}Hf AND ^{172}Hf. Skaali, B. (Oslo Univ. (Norway)); Kalish, R. (Technion-Israel Inst. of Tech., Haifa); Eriksen, J.; Herskind, B. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., A; 238: No. 1, 159-175(27 Jan 1975).

The transient magnetic field IMPAC technique was used to measure the magnetic moments of high-spin states above the rotational band of ^{168}Hf and ^{172}Hf, populated in the reactions ^{156,160}Gd(^{16}O,4n). The average g-factors of these pre-rotational feeding states were deduced to be 0.07 ± 0.04 and 0.14 ± 0.04 for ^{168}Hf and ^{172}Hf, respectively. These results are in agreement with a reduction of the collective g-factors due to a neutron phase transition. (auth)

31508 STRONGLY PERTURBED POSITIVE-PARITY BAND IN ^{167}Yb. Lindblad, T. (Research Institute for Physics, Stockholm 50, Sweden). Nucl. Phys., A; 238: No. 2, 287-300(3 Feb 1975).

High-spin levels of the deformed nuclide ^{167}Yb are studied by in-beam γ-rays utilizing the reaction ^{166}Er(α,3n)^{167}Yb. Cascade and cross-over transitions are observed within a strongly perturbed rotational band. The prevailing single-particle character of this band, which is seen up to the member with $I = 33/2$, is $5/2^+$ [624]. The rotational energies are successfully explained within the unified model with the pairing and Coriolis interactions included, provided the theoretical Coriolis matrix elements are reduced. The theoretical and experimental transition probabilities are found to be in fair agreement. In addition to the positive-parity band two other rotational sequences are observed, namely the $5/2^-$ [523] ground-state band, which is seen up to the member with $I = 25/2$, and a band, which possibly is being built on the $11/2^-$ [505] intrinsic state. The latter is followed up to the member with $I = 19/2$ ($23/2$). (auth)

31509 MAGNETIC MOMENTS OF COMPOUND STATES IN DYSPROSIUM. Alfimenkov, V. P.; Vagov, V. A.; Zamrij, V. N.; Lason, L.; Mareev, Yu. D.; Ovchinnikov, O. N.; Pikelner, L. B.; Salai, S.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). Phys. Lett., B; 53: No. 5, 429-431(6 Jan 1975).

Magnetic moments of neutron resonances in dysprosium have been measured by determining the neutron transmission through a polarized target. A natural Dy target was used, and magnetic moments are given for excited states in ^{163}Dy and ^{161}Dy. (auth)

31510 THE RADIOACTIVE DECAY OF ^{170}Re. Sterna, L. L.; Haustein, P. E. (Yale Univ., New Haven, Conn. (USA). Dept. of Chemistry); Ansaldo, E. J.; Naumann, R. A. (Princeton Univ., N. J. (USA). Dept. of Physics); Ward, T. E. (Indiana Univ., Bloomington (USA)). Phys. Lett., B; 53: No. 5, 432-434(6 Jan 1975).

A new, highly neutron-deficient isotope, ^{170}Re, $T_{\frac{1}{2}} = 8.0 \pm 0.5$ s, has been produced via the ^{159}Tb(^{20}Ne,9n) reaction at beam energies of 180 MeV. The helium-jet transport technique was used to study the decay. Results from singles and coincidence γ-ray spectroscopy are reported. (auth)

31511 NEW ISOTOPE OF YTTERBIUM: ^{161}Yb($T_{\frac{1}{2}} = 4.2$ min). Adam, I.; Beyer, G.; Gonusek, M.; Gromov, K. Ya.; Zibert, Kh. U.; Kalinnikov, B. G.; Latuszynski, A.; Strusny, H.; Yakhim, M. (Joint Inst. for Nuclear Physics, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1572-1576(Aug 1974). (In Russian).

In a search for new neutron-deficient isotopes of the rare earth elements, targets of Ta_2O_5 in 0.1M HCl were irradiated with 660-MeV protons. The energies and intensities of the γ lines arising during the decay of ^{161}Yb were $K\alpha_1$ (100), 78.17 (49), 140.2 (3.3), 188.2 (4.5), 599.8 (39), and 631.3 keV (21). (3 figures, 1 table) (JSR)

Nuclear Properties and Reactions, $190 \leq A \leq 219$

Refer also to abstracts 30939, 30942, 31355, 31440, 31446, and 31541.

31512 (CEA-CONF-2772) NUCLEAR RESONANCE OF GAMMA RAYS AROUND 7 MeV. Lucas, R.; Martinot, M.; Nifenecker, H.; Fagot, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). 1974. 6p. (CONF-740920-16). Dep. NTIS (US Sales Only) $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

The elastic scattering of variable energy photons by various targets (Bi, Pb, Hg, Tl, Ta, Au, Ce, Sn, Y, Zr, Ni) was studied in the energy range of 5 MeV to 8.1 MeV. The results obtained allow the determination of elastic scattering cross sections in this energy range. (3 figures) (auth)

31513 (CONF-750118-3) EXPERIMENTAL SUMMARY. Plasil, F. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 7p. Dep. NTIS $4.00.

From international workshop III on gross properties of nuclei and nuclear excitations; Hirschegg, Kleinwalsertal, Austria (13 Jan 1975).

This paper is concerned with a summary of experimental data presented at the conference. Most of the summary is devoted to very-heavy-ion reactions. Those within the scope of the conference were fusion and quasi-fission, and it is on these that the emphasis is placed. (6 figures, 2 tables) (RWR)

31514 (COO-1265-154, pp 119-121) SEARCH FOR COLLECTIVE VIBRATIONAL EXCITATIONS IN ^{187}Os, ^{189}Os, AND ^{192}Os BY THE (d,d') REACTION. Sharma, H. L.; Hintz, N. M. Sep 1974. In annual report 1974.

31515 (COO-1265-154, pp 124-127) STUDY OF THE SUB-COULOMB NEUTRON TRANSFER ON ^{208}Pb USING ^{12}C IONS. Franey, M.; Lilley, J. S.; Phillips, W. R. Sep 1974. In annual report 1974.

31516 (JINR-P6-8541) DISTRIBUTION OF NEUTRON MULTIPLICITY IN PION CAPTURE BY Pb NUCLEI. Buttsev, V. S.; Vandlik, Ya.; Vylov, Ts.; Ganzorig, Zh.; Gumnerova, L.; Zaitseva, N. G.; Polikanov, S. M.; Savchenko, O. V.; Chultem, D. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 30p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

For the first time it was shown that neutron-deficient isotopes very far from the beta-stability line are produced in negative pion capture. The wide (from 4 to 11) distribution of neutron multiplicity was obtained by means of gamma-ray yields from Tl isotopes produced in the Pb(π^-, xn) reaction. The intensive high-spin-state excitation in ^{196m}Tl(7$^+$) and ^{198m}Tl(7$^+$) was observed in negative pion capture on Pb nuclei. An extraordinary high isomeric ratio $\xi = \sigma_m/\sigma_g = 5.0$ has been observed in ^{198}Tl. (5 figures, 4 tables) (auth)

31517 (LA-5830-T) RADIOCHEMICAL STUDIES OF SOME LOW- AND MEDIUM-ENERGY NUCLEAR REACTIONS PRODUCED BY ACCELERATED TRITONS, DEUTERONS, AND PROTONS. Casella, V. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 141p. Dep. NTIS $7.60.

Thesis.

(I) Excitation functions were measured for the production of ^{196g}Au, ^{196m}Au, ^{198g}Au, ^{198m}Au, ^{199g}Au, ^{195g}Hg, ^{195m}Hg, ^{197g}Hg, ^{197m}Hg, and ^{199m}Hg by 6- to 24-MeV deuteron and triton bombardments of stable ^{197}Au. The bombardments employed the stacked-foil technique and were carried out at the Los Alamos Van de Graaff Facility; the radioactive products were determined by measurement of their characteristic gamma rays with a Ge(Li) detector–pulse height analyzer system. The experimental results were compared with results of compound-nucleus calculations incorporating pre-equilibrium particle emission. (II) E3 isomeric states of ^{93}Y and ^{101}Ag were discovered. Their half-lives are 0.8 ± 0.04 and 3.12 ± 0.12 seconds, respectively. These activities were produced by short bursts of beam on isotopically enriched targets; the decay γ-rays were measured with a Ge(Li) detector–PHA system operated by a computer arrangement. Hindrance factors for the E3 transitions were calculated and discussed. (III) Chemical procedures were developed for the isolation of spallation-produced radioyttrium and radiopotassium from molybdenum and vanadium targets. These procedures incorporate precipitation, solvent extraction, and ion exchange techniques. An overall chemical yield of 96 ± 4% was achieved for yttrium, while the potassium overall chemical yield was 91 ± 3%. The interaction of 800-MeV protons with a thin vanadium target was studied, and cross sections for the formation of ^{42}K and ^{43}K were measured to be 11 mb and 6 mb, respectively, with an estimated 15% error limit. (35 figures, 27 tables) (auth)

31518 (LA-UR-75-326) RADIATIVE CAPTURE GAMMA RAYS FROM THE REACTION ^{208}Pb(n,γ)^{209}Pb FOR 11-MeV INCIDENT NEUTRONS. Drake, D. M.; Arthur, E. D.; Bergqvist, I.; McDaniels, D. K.; Varghese, P. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 4p. (CONF-750303-11). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The spectrum of gamma rays emitted by ^{209}Pb from 11-MeV neutron capture was measured with a Ge(Li) detector. Although the statistical quality of the data is poor, it seems apparent that two-particle, one-hole states, as well as single-particle states, play a prominent role in fast neutron capture in ^{209}Pb. (auth)

31519 (LUNP-7403) PHOTOFISSION IN GOLD AT INTERMEDIATE ENERGY. Areskoug, M.; Schroeder, B.; Lindgren, K.; Andersson, G.; Forkman, B. (Lund Univ. (Sweden). Fysiska Institutionen). Mar 1974. 33p. Dep. NTIS (US Sales Only) $4.75.

By using the thick-target thick-catcher technique the yields of 29 fission products from photofission in ^{197}Au induced by 600 MeV bremsstrahlung have been measured. From these values mass and charge distributions have been determined. The experimental results are compared with cascade-evaporation calculations in combination with calculations based on the liquid drop model. (auth)

31520 (ORNL-TM-4822) Pb(n,xγ) REACTION FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.6 AND 20.0 MeV. Chapman, G. T.; Morgan, G. L. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 54p. Dep. NTIS $5.75.

Numerical values of the differential cross sections for gamma rays produced by neutron reactions with natural lead were measured for neutron energies between 0.6 and 20 MeV. The data were obtained by using an electron linac as a neutron source in conjunction with a NaI spectrometer located at an angle of 125°. The data consist of the doubly differential cross section, $d^2\sigma/d\Omega dE$, for gamma rays between 0.3 and 10.5 MeV for coarse intervals in incident neutron energy and the integrated yield of gamma rays of energy greater than 0.3 MeV with high resolution in the incident neutron energy. The measured results are compared with the current ENDF/B data. (23 figures, 20 tables) (auth)

31521 NUCLEAR MAGNETIC MOMENTS OF ^{205,207,209}Bi ISOTOPES–HYPERFINE STRUCTURE OF THE 15–DAY ^{205}Bi 3067–Å LINE. Mariño, C.A.; Fülöp, G.F.; Groner, W.; Moskowitz, P.A.; Redi, O.; Stroke, H.H. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. Lett. 34: No. 10, 625-628 (10 Mar 1975).

The hyperfine structure of the 3067–Å line of 15–d ^{205}Bi was measured by optical spectroscopy. The results are A($^4P_{1/2}$) = 166(4) $\times 10^{-3}$ cm^{-1}, giving μ = 4.13(11) μ_N, and 192(14) $\times 10^{-3}$ cm^{-1} for the ^{205}Bi–^{209}Bi isotope shift. A reexamination of the ^{207}Bi hfs shows accord with previous spectroscopic results [μ = 4.07(2) μ_N], but not with the recent nuclear orientation finding by Johnston, Kaplan, and Stone that μ (^{207}Bi) is substantially larger than μ (^{209}Bi). Calculations of magnetic moments of odd bismuth isotopes, including configuration mixing and pion–exchange contributions, are in agreement with our experiments. (auth)

31522 THREE-PARTICLE ISOMER OF ^{205}Po. Romanii, I. A.; Klyucharev, A. P.; Lutsik, V. A.; Rakivnenko, Yu. N.; Yatsenko, G. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1691-1693(Aug 1974). (In Russian).

With a pulsed beam of α particles at 37.8 MeV the second isomeric state of the ^{208}Po nucleus was obtained in the reaction ^{204}Pb(α,3n)^{205}Po*2. The energy of the 19/2$^-$ isomeric level was 1460 ± 0.5 keV, and its half life was 57 ± 1 ms. The multipolarity of the 580-keV transition from the isomeric state was E3. The hindrance factor for the E3 transition in comparison with the one-proton evaluation was about 3×10^3, which is completely reasonable for such a complex transition between the configurations $[p(h_{\frac{9}{2}})^2_{4+}n(f_{\frac{5}{2}}{}^{-1})]_{\frac{13}{2}}{}^-$ and $[p(h_{\frac{9}{2}})_0{}^+n(i_{\frac{13}{2}})^{-1}]_{\frac{13}{2}}{}^+$. (JSR)

31523 BREAKUP OF DEUTERONS WITH ENERGY OF 13.6 MeV DURING INTERACTION WITH THE NUCLEI ^{207}Pb AND ^{209}Bi. Grantsev, V. I.; Dryapachenko, I. P.; Kornilov, V. A.; Nemets, O. F.; Pugach, V. M.; Rudenko, B. A.; Sokolov, M. V.; Struzhko, B. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 8, 1703-1704(Aug 1974). (In Russian).

The differential cross sections for the (d,np) reaction on ^{207}Pb and ^{209}Bi were measured at a deuteron energy of 13.6 MeV. The experimental results for the cross sections were compared with calculations made by the Landau and Lifshitz method and by the distorted-wave method with the S-wave interaction of the neutron with the nuclei taken into account. A conclusion was reached on the necessity of considering very high partial waves. (1 figure) (tr-auth)

31524 DISTRIBUTION OF THE M1 STRENGTH IN Au AND Pb. Lone, M. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). v.2 p.314-317 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Information on the fragmentation of the giant dipole resonance in the Pb region is presented and discussed. The information comes from (e,e'), (γ,n), and (γ,γ) reactions, but better nuclear structure calculations are needed to analyze the data quantitatively. (auth)

31525 THE MAGNETIC MOMENT OF THE 8$^+$ STATE IN ^{212}Rn. Witthuhn, W.; Haeusser, O.; Fossan, D. B.; McDonald, A. B.; Olin, A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Phys., A; 238: No. 1, 141-148(27 Jan 1975).

The g-factor of the isomeric 8^+ level of ^{212}Rn ($T_{\frac{1}{2}}$ = 1.0 μs) was measured by the stroboscopic method. The result, g = +0.911 ± 0.012, indicates a small deviation from predictions based on core polarization blocking. (auth)

31526 EVIDENCE FOR THE ISOSCALAR MONOPOLE AND THE ELECTRIC DIPOLE SPIN FLIP RESONANCE IN HEAVY NUCLEI. Pitthan, R.; Buskirk, F. R.; Dally, E. B.; Dyer, J. N.; Maruyama, X. K. (Naval Postgraduate School, Monterey, Calif. (USA)). v.2 p.306-309 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Results of (γ,n) and (e,e′) reactions are compared to establish evidence for the isoscalar monopole and the electric dipole spin flip resonance in ^{197}Au and ^{208}Pb. The results are compared with DWBA angular distribution calculations. (NL)

31527 EXCITATION OF GIANT RESONANCES BY INELASTIC PROTON SCATTERING AT 155 MeV. Marty, N.; Morlet, M.; Willis, A.; Comparat, V.; Frascaria, R. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 238: No. 1, 93-110(27 Jan 1975).

The inelastic proton spectra in the giant resonance region have been studied with 155 MeV protons on ^{27}Al, ^{40}Ca, Fe, ^{89}Y, ^{115}In, Sn, ^{165}Ho, ^{181}Ta, ^{197}Au, ^{208}Pb, and ^{209}Bi. For all nuclei a strong resonance at E = (63.0 ± 1.5) $A^{-\frac{1}{3}}$ MeV is seen, with an angular distribution in agreement with L = 2 DWBA calculations. The resonance exhausts from 50% (^{40}Ca) to 14% of the energy-weighted sum rule. Fine structure similar to that reported in electron scattering experiments is observed for ^{208}Pb. In addition, some other possible excitations are discussed. (auth)

31528 UPPER AND LOWER BOUNDS FOR THE QUADRUPOLE MOMENT AND OCTUPOLE STRENGTH OF THE FIRST EXCITED 3^- STATE IN ^{208}Pb. Guidetti, M. (Politecnico di Torino (Italy)); Rowe, D. J.; Chow, H. (Toronto Univ., Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 238: No. 2, 225-239(3 Feb 1975).

The types of configuration necessary to describe the observed static quadrupole moment of an excited $J^\pi = 3^-$ state and its octupole transition rate to the ground state are investigated for the first excited 3^- state of ^{208}Pb. It is done by calculating the range of B(E3) values and quadrupole moments that simultaneously exist within a variety of configuration spaces. The spaces investigated include those of the TDA and RPA particle-hole models in which particle-hole excitations are coupled to a 2^+ phonon. It is shown that it would be extremely difficult for any of the models considered to explain the observed properties of the above state. (auth)

31529 SEMI-DECOUPLED BANDS IN THE EVEN Hg ISOTOPES. Neergaard, K. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)); Vogel, P.; Radomski, M. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., A; 238: No. 2, 199-224(3 Feb 1975).

The odd-parity yrast states of the isotopes $^{190-200}$Hg are studied in a model of two quasi-particles coupled to an oblate rotor and interacting by a surface delta interaction. The experimental energy spectra and the enhancement of E2 transition probabilities are well explained by the model. The pure Coriolis coupling problem (i.e., the problem obtained when the residual interaction is suppressed) is investigated in detail. It is shown that the main effect of the Coriolis force is to decouple the high-spin quasiparticle originating in the neutron Li $i_{13/2}$ subshell from the system of the rotor and the low-spin quasiparticle. The coupling of a particle to an axially symmetric rotor, which has an intrinsic spin along its symmetry axis, is studied and a good approximate solution to the problem is derived. (auth)

31530 THE CROSS-SECTIONS FOR THE BINARY AND TERNARY FISSION OF PLATINUM INDUCED BY 14, 18 AND 23 GeV PROTONS. Antanasijevic, R.; Todorovic, Z.; Juric, M. (Institut za Fiziku, Belgrade (Yugoslavia)). Z. Phys.; 269: No. 4, 385-386(Sep 1974).

The cross-sections for the binary and ternary fission of platinum were determined using a polycarbonate as the detector of fission fragments. The incident proton energies were 14, 18 and 23 GeV. (auth)

31531 LEVEL STRUCTURE OF ^{199}Hg. Satyanarayana, G.; Narasimha Raju, M. L.; Parthasaradhi, K. (Andhra Univ., Visakhapatnam, India). Curr. Sci. (India); 44: No. 4, 117-118 (20 Feb 1975).

The applicability of the core-excitation model to all the electromagnetic properties of the first two excited levels of ^{199}Hg is tested. In addition, the properties are also compared with the estimates based on the single-particle and Kisslinger–Sorensen models. Excellent agreement is obtained between the predictions of the core-excitation model and the corresponding experimental values. (1 table) (RWR)

31532 TIME-DEPENDENT DIRECTIONAL CORRELATIONS OF ^{199m}Hg IN LIQUID Hg, SOLID Hg, AND $HgCl_2$. Edelstein, W. A.; Pound, R. V. (Harvard Univ., Cambridge, MA). Phys. Rev., B; 11: No. 3, 985-989(1 Feb 1975).

Time-directional correlations of the 374- and 158-keV γ rays of ^{199m}Hg were studied with sources in the form of liquid Hg, frozen Hg, and dry crystalline $HgCl_2$. The time-dependent anisotropy in the liquid at room temperature shows no observable disturbance over several lifetimes. The integral anisotropy in the liquid indicates mixing of E5 with the predominantly M4 first γ ray with an M4/E5 mixing ratio δ = 0.092 ± 0.015. The half-life of the intermediate state was determined to be 2.47 ± 0.05 nsec. Time-dependent directional correlations in frozen emulsified Hg show a quadrupole interaction $eQ(\partial^2V/\partial z^2)/h$ = 198 ± 40 MHz. The time-dependent coincidence rate in $HgCl_2$ shows a quadrupole interaction $eQ(\partial^2V/\partial z^2)/h$ = 1271 ± 30 MHz. If the second γ ray is a rotational transition, the quadrupole moment of the intermediate state determined from the intermediate-state E2 lifetime can be combined with the nuclear-quadrupole-resonance frequency of ^{201}Hg in $HgCl_2$ to give a quadrupole moment for ^{201}Hg of 0.39 ± 0.02 b. This result is in excellent agreement with the value of 0.41 b obtained by Murakawa from the hyperfine structure of atomic mercury. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 30825, 30853, 30854, 31301, 31316, 31355, 31491, 31513, and 31575.

31533 (AD-786774) INVESTIGATIONS IN THE THEORY OF ELECTRON REACTIONS WITH NUCLEI. Final Report, September 1966–September 1973. Onley, D. S.; Wright, L. E. (Ohio Univ., Athens (USA)). Aug 1974. 12p. (AROD-6415.13-P). NTIS $3.25.

The report covers the research activities on contracts concerning the electromagnetic structure of the atomic nucleus and the interaction of atomic nuclei with radiation and high-energy electrons. A short overview of the different projects attempted is given as follows: the distorted-wave program (for electron scattering), corrections to electron scattering, photofission and electrofission, microscopic charge distributions, collective models for electron scattering form factors, real and virtual radiation distributions, backward scattering and magnetic distributions, K-meson capture, mathematical methods for functions of matrices, and zero-point oscillations. (GRA)

31534 (AD-787810) FISSION YIELD DETERMINATIONS. Final Technical Report, See Also AD-762746. Moore, C. F.; Hoffman, G. W (Texas Univ., Austin (USA)). 1973. 107p. NTIS $5.25.

A summary of the work done to date in connection with fission yield measurements and fission-related studies is given. During the past three years, research aimed at the ultimate extraction of isotopic fission yields from neutron-induced fission of ^{233,235,238}U and ^{239}Pu was studied. (GRA)

31535 (AERE-R-7468) SYSTEMATICS FOR NEUTRON REACTIONS OF THE ACTINIDE NUCLEI. Lynn, J. E. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1974. 99p. Dep. NTIS (US Sales Only) $8.00. UK £2.00.

A scheme was developed for the calculation of neutron cross sections of actinide nuclei up to about 3 MeV incident neutron energy. It is based on elementary Hauser–Feshbach theory, the statistical model of level densities (with modifications for low excitation energies), the giant dipole resonance model for electromagnetic transitions, and a parametrization of the double-humped barrier in the fission process. The parameters for the scheme are backed by experimental data wherever possible. It is concluded that many cross sections (including capture and fission) can be calculated with a likely error of about 25% (one standard deviation) by this scheme at its present stage of development; this is of value for provision of data for technological purposes where none exists experimentally. Some interesting nuclear physics conclusions also emerge from the present work. The density of states of intrinsic excitation at the deformation corresponding to the intermediate fission barrier appears to be

3 to 5 times the density at normal excitation, but there is not such a great difference at the outer barrier. There are significant odd–even differences in the barrier penetrability parameters and a strong odd–even difference in the heights of the intermediate barrier (relative to the ground state). (35 figures, 11 tables, 112 references) (auth)

31536 (AERE-R-7680) ASSESSMENT OF KNOWN INDEPENDENT YIELDS AND THE CALCULATION OF THOSE UNKNOWN IN THE FISSION OF ^{232}Th, ^{233}U, ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu, AND ^{241}Pu. Crouch, E. A. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). May 1974. 43p. Dep. NTIS (US Sales Only) $5.25. UK £1.00.

Known fractional independent and fractional cumulative yields were used to calculate the parameters of Gaussian distributions modified to take account of odd/even atomic number effects. These distributions were used to estimate unknown fractional independent yields. (auth)

31537 (CEA-CONF-2852) EVALUATION OF NEUTRON–NUCLEUS CROSS SECTIONS IN HEAVY NUCLEI WITH A COUPLED CHANNEL MODEL IN THE RANGE OF ENERGY FROM 10 keV TO 20 MeV. Lagrange, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). 1973. 11p. (CONF-730320-7). Dep. NTIS (US Sales Only) $4.00.

From EANDC topical meeting; Tokyo, Japan (27 Mar 1974).

The optical model with coupling channels is used in developing a code used to search for a unique and physically coherent parameter set which would cover the range of incident energies from 10 keV to 20 MeV for A = 232 to 242 nuclei. Total, direct-scattering, and compound nucleus formation cross sections, strength functions, angular distributions, and neutron transmission coefficients are calculated using uranium 238 and thorium 232. (JFP)

31538 (CEA-CONF-2854) EVALUATION OF THE (n,xn) AND (n,xnf) CROSS SECTIONS FOR HEAVY NUCLEI WITH THE STATISTICAL MODEL. Jary, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1973. 8p. (CONF-740320-6). Dep. NTIS (US Sales Only) $4.00.

From EANDC topical meeting, Tokyo, Japan (27 Mar 1974).

A method is presented used to calculate the (n,nx) and (n,xnf) cross sections for heavy nuclei having mass numbers from 232 to 239 and for incident neutron energies from 2 to 15 MeV. Applications are made to the nuclei, uranium-236, uranium-237, and uranium-238. (JFP)

31539 (CEA-CONF-2855) STATISTICAL MODEL EVALUATION OF NEUTRON-INDUCED FISSION AND CAPTURE CROSS SECTIONS OF HEAVY NUCLEI FOR ENERGIES IN THE RANGE 3 keV TO 1 MeV. Thomet, P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1973. 8p. (CONF-740320-9). Dep. NTIS (US Sales Only) $4.00.

From EANDC topical meeting; Tokyo, Japan (27 Mar 1974).

A method is presented which was used for evaluation of fission and capture cross sections induced by neutrons with energies from 3 keV to 1 MeV on a set of heavy nuclei. The first application of this method was to the following even–even nuclei: uranium-236, plutonium-238, and plutonium-240. (JFP)

31540 (CEA-R-4647) STATISTICAL MODEL EVALUATION OF (n,xn) AND (n,xnf) CROSS SECTIONS OF THE URANIUM ISOTOPES ^{232}U TO ^{239}U FROM 2 MeV TO 15 MeV. Jary, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jan 1975. 47p. (In French). Dep. NTIS (US Sales Only) $5.50.

A method for a statistical model evaluation of fission (n,2n) and (n,3n) cross sections for 2-MeV to 15-MeV neutrons on uranium isotopes is presented. It consists of the determination of fission width parameters by a fit to various experimental fission cross sections. This method makes use of neutron transmission coefficients from a coupled-channels model and neutron, fission, and radiative widths calculated by the statistical model including Fermi gas model level densities. Results are presented for the nuclei ^{232}U to ^{239}U. (21 figures, 9 tables) (auth)

31541 (CNRS-CSNSM-1970-1972) PROGRESS REPORT, 1970–1972. (Centre National de la Recherche Scientifique, 91–Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). 1972. 78p. INIS.

The results of research carried out by the nuclear spectrometry section are presented: radioisotope research; extra-nuclear effects; nuclear archeology; equipment and techniques. The nuclear level schemes are given for ^{155}Dy, ^{157}Dy, ^{159}Dy, ^{185}Ir, ^{187}Ir, ^{189}Ir, ^{189}Au(^{185m}Hg + ^{185}Hg → ^{185}Au)^{219}Rn, ^{223}Ra, ^{225}Ac, ^{227}Ac (angular momenta), ^{228}Th, ^{233}Pa, some low-energy electron lines of ^{233}Th and the spectra corresponding to the deep double ionization of ^{109}Ag. Research was carried out by the mass spectrometry section on the applications of on-line mass spectrometry to nuclear physics (fission, exotic nuclei), nuclear astrophysics (spallation cross sections and the production of ^{10}Be in ^{11}B(p,2p)^{10}Be reactions between 150 and 600 MeV), half-life of ^{10}Be, high-energy atomic electron capture and the effects of irradiation on natural minerals. The isotope separators used are described. (INIS)

31542 (CONF-750303-16) DIRECT COMPARISON OF DIFFERENT EXPERIMENTAL TECHNIQUES FOR MEASURING NEUTRON CAPTURE AND FISSION CROSS SECTIONS FOR ^{239}Pu. Gwin, R.; Weston, L. W.; Todd, J. H.; Ingle, R. W.; Weaver, H. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A comparison of the results of two different experimental methods of measuring the neutron absorption and fission cross sections for ^{239}Pu is made. These measurements were normalized at thermal energy and extend to 200 keV. The ratio of the neutron capture to fission cross section for ^{239}Pu derived in these two experiments is shown to be in good agreement. (1 figure, 1 table) (auth)

31543 (CONF-750303-32) INTERMEDIATE STRUCTURE IN THE ^{238}U NEUTRON CAPTURE CROSS SECTION. Perez, R. B.; de Saussure, G. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Recent measurements of the ^{238}U neutron capture cross section show large fluctuations in the unresolved resonance region. To test whether or not the observed long-range fluctuation of the neutron capture represent departures from the compound nucleus model, the Wald–Wolfowitz runs and correlation tests were applied to the ^{238}U neutron capture data obtained at ORELA. The Wald–Wolfowitz runs test deals with the statistic, R, which is the number of unbroken sequences of data points above or below a given reference line. This statistic is to be compared with the expected value of runs $E(R) \pm \sigma(R)$ arising from randomly distributed data. In the correlation test the first serial correlation coefficient of the data as well as its expected value and variance were computed for a set of random data. In both tests the probability, P, for the given statistical entity to depart from its expected value by more than ϵ standard deviations is computed. Both tests confirm the presence of intermediate structure between 5 and 100 keV. The range of the structure far exceeds the width of the experimental resolution and level widths. (2 figures, 3 tables) (auth)

31544 (CONF-750303-39) REPRESENTATION OF THE NEUTRON CROSS SECTIONS IN THE UNRESOLVED RESONANCE REGION. de Saussure, G.; Perez, R. B. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Some limitations of the statistical approach to the representation of cross sections in the unresolved region are discussed; it is suggested that the actual Doppler-broadened cross sections should be used instead. (5 figures) (auth)

31545 (CONF-750303-41) MEASUREMENT OF THE ^{238}U CAPTURE CROSS SECTION SHAPE IN THE NEUTRON ENERGY REGION 20 TO 550 keV. Spencer, R. R.; Kaeppeler, F. (Oak Ridge National Lab., Tenn. (USA); Kernforschungszentrum Karlsruhe (F. R. Germany)). [nd]. 3p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The Karlsruhe 800-l liquid scintillator detector and 3 MV pulsed Van de Graaff were used to measure the shape vs. neutron energy of the ^{238}U capture yield relative to a gold capture sample and relative to ^{235}U fission. The resulting cross section shape computed from the gold capture cross section is consistent with that computed from a recent evaluation of the ^{235}U fission cross section. Below 100 keV a significant intermediate structure is observed which corresponds to that in recent ORNL data. (1 figure, 2 tables) (auth)

31546 (CONF-750303-45) MEASUREMENT OF THE NEUTRON CAPTURE CROSS SECTIONS OF THE ACTINIDES. Weston, L. W.; Todd, J. H. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 3p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The capture cross sections of the isotopes heavier than ^{239}Pu are of great importance for the core physics, fuel recycle, and waste management for power reactors. Since total cross sections are not sufficient, a program for the measurement of these needed capture cross sections is being carried out at ORNL. Measurements have been almost completed on ^{240}Pu, ^{241}Pu, and

^{241}Am, and have been planned for ^{242}Pu and possibly ^{237}Np and ^{243}Am. The capture gamma-ray detector used is the "total energy detector," which is a modification of the Moxon–Rae detector. Fission, when present, is detected with fast neutron counters. Results obtained on ^{240}Pu, ^{241}Pu, and ^{241}Am will extend continuously from thermal neutron energies to 350 keV. The cross sections are normalized at thermal neutron energies, and the neutron flux is measured relative to the ^{10}B(n,α) cross section up to 2 keV and ^{6}Li(n,α) at higher neutron energies. The accuracy of the techniques used varies with the sample but is about 8%. With such cross sections the long-range management of the actinides produced in power reactors can be planned on a more systematic basis. (4 figures) (auth)

31547 (FEI-441) NEUTRON INTERACTION AT ENERGY 14.36 MeV WITH NUCLEI ^{232}Th AND ^{238}U. Sal'nikov, O. A.; Lovchikova, G. N; Kotel'nikova, G. V.; Trufanov, A. M.; Fetisov, N. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

A study of the spectra from neutron inelastic scattering by ^{232}Th and ^{238}U by the time-of-flight method in cylindrical geometry is described. Nuclear temperatures and level density parameters were obtained, as well as angular distributions of evaporation neutrons. (7 figures, 6 tables) (tr-auth)

31548 (INIS-mf-1383, pp 83-89) APPLICATION OF THE VARIATIONAL PRINCIPLE TO THE DERIVATION OF ISOTOPE COMPOSITION KINETIC EQUATION AND THE USE OF THE GRADIENT METHOD IN THE OPTIMIZATION STUDIES ON THE TRANSURANIUM ELEMENT BUILDUP IN THE NEUTRON FLUX. Apseh, V. A.; Khromov, V. V. 1973. (In Russian).

A method is described for the calculation of the optimum neutron flux regime for the buildup of transuranium elements. The results of one computer calculation using this method were reported. A small perturbation formula was obtained by the variational principle. The formula obtained was used in the gradient method of optimization of transuranium element buildup. As an example, the buildup of ^{243}Am by the transition ^{242}Pu(n, γ)^{243}Pu(β^-)^{243}Am was examined. The program INTREL was constructed for solution of problems by this method. The dependence of the concentration of ^{243}Am and the efficiency on the time during different irradiation periods and neutron flux of 10^{15} n/cm^2 was shown. (tr-INIS)

31549 (JINR-E7-8610) TWO APPROACHES TO THE PROBLEM OF SYNTHESIZING TRANSFERMIUM ELEMENTS. Flerov, G. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 14p. Dep. NTIS (U. S. Sales Only) $4.00.

The lasting dispute about the discovery of elements 102 to 105 and presently 106 has led to the fact that no conventional names are so far given to these elements. Moreover, some recent publications contain criticism of the synthesis and identification methods developed at Dubna. In this paper the two techniques used for synthesizing and identifying these elements are compared in terms of reliability and the amount of information extracted. (auth)

31550 (LA-UR-75-288) (n,f) CROSS SECTIONS FOR EXOTIC ACTINIDES. Wilhelmy, J. B.; Britt, H. C.; Gavron, A.; Konecny, E.; Weber, J. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 5p. (CONF-750303-44). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Neutron-induced fission cross sections were obtained for 26 actinide nuclei by using (^{3}He,df) and (^{3}He,tf) reactions to determine fission probabilities and then multiplying these values by calculated compound-nucleus neutron reaction cross sections. Comparison with existing (n,f) data shows this to be a feasible approach for obtaining reliable estimates for (n,f) cross sections where direct measurements are not possible. Theoretical developments in interpreting fission probability measurements are discussed. (8 figures, 1 table) (auth)

31551 (LA-UR-75-319) PARAMETERS OF THE SUBTHRESHOLD FISSION STRUCTURE IN ^{240}Pu. Auchampaugh, G. F.; Weston, L. W. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 7p. (CONF-750303-5). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The neutron subthreshold fission cross section of ^{240}Pu was measured from 500 eV to 10,000 eV using the Oak Ridge Electron Linear Accelerator neutron facility. A total of 82 fission widths were obtained from area and shape analysis of those resonances which define the class II states at ≅782 eV, ≅1406 eV, ≅1936 eV, and ≅2700 eV. The average square of the coupling matrix element for the first three class II states is 4.08 ± 1.63 eV. The average class II fission width is 2.47 ± 0.96 eV. Approximately 22 clusters of class I resonances were observed below 10 keV, which results in a value of 450 ± 50 eV for the average class II level spacing. Under the assumption of parabolic inner and outer barriers, the following barrier parameters were obtained: $V_A - B_n/\hbar\omega_A = 0.59 \pm 0.06$ and $V_B - B_n/\hbar\omega_B = 0.54 \pm 0.06$. (1 figure, 3 tables) (auth)

31552 (LA-UR-75-323) SPIN DETERMINATION OF RESONANCES IN ^{235}U. Keyworth, G. A.; Olsen, C. E.; Moses, J. D.; Dabbs, J. W. T.; Hill, N. W. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 5p. (CONF-750303-22). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A polarized beam of neutrons and a polarized ^{235}U target were used to determine the spins of resonances below 150 eV. Most spins are assigned by inspection of the data; others by comparison with multilevel or single-level fits. Previously published data on fission fragment angular distributions, in conjunction with the spin assignments, indicate that two or more fission channels are available to each spin state. The ratio of symmetric to asymmetric fission appears to be uncorrelated with the resonance spin. (auth)

31553 (LA-UR-75-341) SPECTRUM AND SHIELDING MEASUREMENTS AND CALCULATIONS OF NEUTRONS PRODUCED BY 800 MeV PROTONS. Veeser, L. R.; Russell, G. J.; Arthur, E. D.; Seeger, P. A.; Sommer, W. F.; Drake, D. M.; Fluharty, R. G.; Bentley, R. F. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 5p. (CONF-750303-43). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Measurements were made to check calculation of the neutron flux produced by 800-MeV protons on a cylinder of depleted uranium and computations of the energy-dependent neutron flux as a function of thickness for a rectangular shield surrounding the target. A proton recoil spectrometer was used to measure neutron fluxes from the shield between 300 keV and 7 MeV. Agreement was obtained between the proton recoil data and Monte Carlo calculations for shields composed of steel and gypsum for thicknesses between 0.48 m and 1.37 m. Agreement is good at most angles for energies above 1 MeV. (5 figures) (auth)

31554 (LA-UR-75-360) MEASUREMENT, ANALYSIS, AND IMPLICATIONS OF THE FISSION CROSS SECTION OF THE IMPORTANT FISSIONABLE ISOTOPES. Moore, M. S. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 18p. (CONF-750303-28). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Recent measurements on the resonance cross sections of isotopes of uranium and plutonium are reviewed, with the objective of determining average parameters suitable for calculations at higher energies. The average parameters obtained are useful in two ways: they provide the necessary input for statistical calculations of resonance cross sections in the unresolved region, and they provide a normalization point for the calculation of smooth cross sections above the unresolved region. The particular problem addressed is the systematic trend of average fission cross sections from 3 to 5 MeV, which have been found to follow the equation $\sigma_f = -39.031 + 17.231\ Z^2/A^{\frac{1}{2}}$. It is found that a very simple statistical model calculation, based on R-matrix parameters which adequately describe the total cross section from 20 keV to 20 MeV, can provide a qualitative understanding of this systematic behavior. (15 figures, 1 table) (auth)

31555 (LUNP-7311) PHOTOFISSION IN GOLD WITH 600 MeV BREMSSTRAHLUNG. Areskoug, M.; Schroeder, B.; Lindgren, K. (Lund Univ. (Sweden). Fysiska Institutionen). Nov 1973. 38p. Dep. NTIS (US Sales Only) $5.00.

By using a thick-target thick-catcher arrangement, the relative yields of 9 fission products from the photofission in ^{197}Au induced by 600 MeV bremsstrahlung have been measured in both the catcher foils and the target. The yields of 27 other fission products have been measured only in the catcher foils. The values obtained have been used to determine mass and charge distributions and recoil properties. The peak value of the mass distribution is at 92.6 ± 0.6 amu, and the FWHM is 30.9 ± 1.7 amu. The FWHM of the charge dispersion is 2.18 charge units, and the most probable charge number varies with A according to $Z_p = (1.08 \pm 0.25) + (0.4209 \pm 0.0026)\ A$. The ranges are found to decrease linearly with increasing A. The experimental results are compared with

results from cascade-evaporation calculations and calculations based on the liquid drop model as well as the UCD hypothesis for charge distribution. (auth)

31556 (ORO-1067-13) PROGRESS REPORT, 31 DECEMBER 1974. (Triangle Universities Nuclear Lab., Durham, N. C. (USA)). 1974. Contract AT(40-1)-1067. 58p. (TUNL-12). Dep. NTIS $6.00.

Brief reports are given of work in the areas of neutron and fission physics, charged-particle reactions, accelerator development, and nuclear theory. Lists of personnel and publications are also included. (RWR)

31557 (PTB-FMRB-60) CALCULATION OF AVERAGE CROSS SECTIONS FOR SOME THRESHOLD REACTIONS IN THE CALIFORNIUM-252 FISSION NEUTRON SPECTRUM. Alberts, W. G. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany). Forschungs- und Messreaktor). Feb 1975. 16p. Dep. NTIS (U. S. Sales Only) $4.00.

Cross sections averaged over the ^{252}Cf spontaneous fission neutron spectrum were calculated for 16 activation and fission reactions used in fast neutron measurements, proceeding from sets of energy-dependent cross section data evaluated by Zijp, Voorbraak, and Nolthenius and from recent ^{252}Cf fission neutron spectrum measurements. (auth)

31558 (RLO-2227-T7-24) STRUCTURE OF THE FISSION TRANSITION NUCLEUS ^{227}Ra. Groening, H. R.; Loveland, W. D. (Oregon State Univ., Corvallis (USA). Dept. of Chemistry). 1974. 41p. Dep. NTIS $5.25.

The height of the fission barrier and the character of the low-lying single-particle levels were determined for the fission transition nucleus ^{227}Ra by fitting the energy variation of the fission cross section and fragment angular distributions in the neutron energy range 3.6 < En < 4.1 MeV by using a Hauser–Feshbach formalism. The best fit to the experimental data gave a fission barrier height $E_f = 8.2 \pm 0.1$ MeV and a single-particle state sequence at the barrier of $^3/_2$, $^1/_2$, $^5/_2$, $^1/_2$, which agrees very well with the theoretical predictions of Nix and Moller. An extension of the calculations to higher neutron energies (4.7 < En < 9.0) allowed deduction of K_0^2 and the transition nucleus level density as a function of excitation energy. A discontinuity in the K_0^2 values suggests a value of the pairing gap parameter ($2\Delta_f$ = 2.7 MeV) that is considerably larger than the corresponding one at the equilibrium deformation ($2\Delta_g$ = 1.7 MeV). The transition nucleus and residual nucleus level densities were compared with theoretical calculations, and support the view that a collective rotational and vibrational enhancement of the intrinsic nuclear level density is necessary to account for the experimental data. (7 figures, 4 tables) (auth)

31559 (UCRL-75912) ALTERNATIVE THERMONUCLEAR n-CAPTURE PATH TO THE SUPERHEAVY ISLAND. Meldner, H. W.; Nuckolls, J.; Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. 31p. (CONF-740646-6). Dep. NTIS $4.75.

From Nobel symposium on superheavy elements; Ronneby, Sweden (10 Jun 1974).

Thermonuclear neutron-capture approaches to heavy transuranium element synthesis are investigated. Certain features of capture experiments using thermonuclear macroexplosives are reanalyzed in view of recent results of nuclear shell-structure theory and theoretical developments in laser-energized fusion microexplosions. The microexplosion conditions for prompt multiple neutron capture are estimated for the simplest moderation techniques. Speculations are made on some practical neutron-capture paths to the superheavy island, especially a hybrid approach, using both macro- and microexplosion events. (10 figures) (auth)

31560 (UCRL-76219) NEUTRON-INDUCED FISSION CROSS SECTIONS OF ^{233}U, ^{234}U, ^{236}U, AND ^{238}U WITH RESPECT TO ^{235}U. Behrens, J. W.; Carlson, G. W.; Bauer, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Feb 1975. 7p. (CONF-750303-1). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Ratios of the neutron-induced fission cross sections of ^{233}U, ^{234}U, ^{236}U, and ^{238}U relative to ^{235}U and of ^{238}U relative to ^{233}U were measured with fission ionization chambers at the LLL 100-MeV electron linear accelerator. The time-of-flight technique was used to measure the cross section ratios as a function of neutron energy from 0.1 to 30 MeV, except for the ^{233}U : ^{235}U and ^{238}U : ^{233}U ratios, which were measured from 0.001 to 30 MeV, and 1 to 30 MeV, respectively. The continuous energy spectrum of the neutron source allowed covering the entire energy range of each ratio in one measurement. The threshold cross section method was used to normalize the ratios independently of other cross section measurements. Typical energy resolutions of the data are 5% at 20 MeV and 1.5% at 1 MeV. Most of the data have counting uncertainties smaller than 4%. Systematic errors are discussed, and current results are compared with previous measurements. (9 figures, 4 tables) (auth)

31561 (UCRL-76508) ^{235}U FISSION CROSS SECTION MEASUREMENTS RELATIVE TO NEUTRON–PROTON SCATTERING. Sidhu, G. S.; Czirr, J. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Feb 1975. 6p. (CONF-750303-40). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The energy dependence of the fission cross section of ^{235}U with respect to the n-p scattering reaction was measured for neutron energies from 0.8 to 20 MeV. The LLL linac target was used as the pulsed neutron source; neutron energies were measured by time-of-flight techniques. A ^{235}U ion chamber was designed and operated to make the fission detection efficiency independent of the angular distribution of fission fragments. The neutron flux monitor consisted of an annular polyethylene radiator with a shielded proton recoil detector. Data in the energy range from 3 to 20 MeV were obtained with a 3.3 mg/cm^2 radiator; a 0.31 mg/cm^2 radiator was used for the range from 0.8 to 4 MeV. Both sets of data were normalized to yield the average fission cross section value of 1.198 b in the overlapping region from 3 to 4 MeV. Total error in the relative ^{235}U(n,f) cross section is ±1% below 7 MeV, ±2% at 14 MeV, and ±6% at 20 MeV. (auth)

31562 SIMULTANEOUS EVALUATION OF THE FISSION CROSS-SECTIONS OF ^{235}U, ^{239}Pu, AND ^{238}U AND THE CAPTURE CROSS-SECTION OF ^{238}U IN THE ENERGY RANGE 100 eV TO 20 MeV. Sowerby, M. G. (United Kingdom Atomic Energy Authority, Harwell, Eng.); Patrick, B. H.; Mather, D. S. Ann. Nucl. Sci. Eng.; 1: No. 7/8, 409-435(Jul 1974).

The fission cross sections of ^{235}U, ^{238}U and ^{239}Pu and the capture cross section of ^{238}U were evaluated in the energy range 100 eV to 20 MeV. Below 100 keV, the cross sections were considered independently, but at energies above 100 keV, all the accepted data on the cross sections and their ratios were used simultaneously in a least squares fitting procedure, using weighting functions derived from assigned errors. The evaluated cross sections and their associated uncertainties are given together with recommendations for further experimental measurements. (auth)

31563 NUCLEAR FISSION AS A SUDDEN PROCESS. Delchev, Ya. I.; Petkov, I. Zh. (Inst. of Nuclear Research and Radiation Energy, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 8, 1057-1059(1974). (In Russian).

The values of log $t_{\frac{1}{2}}$ were calculated for a series of spontaneously fissioning nuclei, and the results obtained are tabulated and compared with either experimental or previous theoretical results. (3 tables) (JSR)

31564 $\bar{\nu}_p$ MEASUREMENTS FOR ^{239}Pu BELOW 2 MeV. Walsh, R. L.; Boldeman, J. W. (Australian Atomic Energy Commission Research Establishment, Sutherland). Ann. Nucl. Sci. Eng.; 1: No. 6, 353-355(Jun 1974).

The large liquid scintillator method has been used to measure the energy dependence of $\bar{\nu}_p$ for ^{239}Pu below 2 MeV. No fine structure in the low energy region was observed. An analysis of all existing ^{239}Pu $\bar{\nu}_p$ data below 5 MeV suggests a two-line energy dependence with a change of slope at about 800 keV. (auth)

31565 MOESSBAUER STUDIES OF AFTER ALPHA DECAY EFFECTS OF ^{237}Np IN DELTA PLUTONIUM. Gal, J. (Israel Atomic Energy Commission, Beersheba); Hadari, Z.; Bauminger, E. R.; Nowik, I.; Ofer, S. Solid State Commun.; 15: No. 11-12, 1805-1808(15 Dec 1974).

Mössbauer studies of the 59.6-keV gamma ray emitted from ^{237}Np in δ-Pu show that the shape and the center of gravity of the emission spectrum change significantly with temperature between 8 and 80 K. The results can be very well explained by assuming that the Np^{5+} ions produced after the alpha decay of ^{241}Am transform with a rate of ~10^8 sec^{-1} to the Np^{4+} valence state. (auth)

31566 PRODUCTION OF ACTINIDE ELEMENTS USING SECONDARY REACTIONS INDUCED BY 19 GeV ELECTRONS. Wolf, K. L.; Unik, J. P.; Horwitz, E. P.; Bloomquist, C. A. A.; Henderson, D.; Sjoblom, R. (Argonne National Lab., IL). J. Inorg. Nucl. Chem.; 37: No. 1, 21-24(Jan 1975).

Cumulative yields of actinide elements produced by secondary reactions have been measured in a uranium target following 19 GeV electron irradiation. Identification of actinide isotopes, the heaviest being ^{248}Cf, was made by alpha spectroscopy of chemically separated fractions. These results are compared to previously measured yields for secondary reactions induced by high-energy protons. (auth)

31567 TRANSURANIUM ELEMENTS. Gol'danskii, V. I.; Polikanov, S. M. Studies in Soviet Science. New York; Plenum Publishing Corporation (1973). 169p. (ISBN-0-306-10901-8). $25.00.

Translated from Russian by J. E. S. Bradley.

This volume discusses the history, physical and chemical properties, and distinctive features of the transuranium elements and offers new hypotheses on the existence of a new region of elements. With a fundamental outline of radioactive decay as a starting point, current views on nuclear fission are given. Methods for making superheavy elements are described, and evidence is presented on the position of the transuranium elements in the periodic table and on the radioactive decay of various isotopes. This book is essentially a revised and enlarged edition of Gol'danskii's "New Elements in the Periodic System." (50 figures, 18 tables) (RWR)

Nuclear Theory

Refer also to abstracts 30803, 30901, 31057, 31110, 31354, and 31544.

31568 (BNL-19498) SUMMARY REMARKS. Vary, J. P. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1974. 18p. (CONF-740740-3). Dep. NTIS $4.00.

From 2nd high energy heavy ion summer study; Berkeley, California, USA (15 Jul 1974).

Certain aspects of new data and theory which have been presented at this conference are drawn together in order to gain new perspectives. Some microscopic nuclear structure and reaction highlights are reviewed and suggestions are presented. (7 figures) (auth)

31569 (BNL-tr-586) INVESTIGATION OF THE MECHANISM OF INELASTIC SCATTERING OF 14-MeV NEUTRONS BY NUCLEI IN A WIDE MASS NUMBER RANGE. Zeliger, D.; Zeidel, K.; Hermsdorf, D.; Sassonov, S.; Toneev, V. D. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. Translation by S. J. Amoretty of Paper Presented at 2nd All-Union Conference on Neutron Physics, 1973. (CONF-730538-9). 21p. Dep. NTIS $4.25.

From national Soviet conference on neutron physics; Kiev, USSR (28 May 1973).

The investigation of the mechanism of inelastic scattering of 14-MeV neutrons by analyzing the neutron emission spectra within the framework of the pre-equilibrium and equilibrium statistical models is continued. (JFP)

31570 (CEA-CONF-2721) TRANSFER REACTIONS INDUCED BY HEAVY IONS. Mallet-Lemaire, M. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1974. 24p. (In French). (CONF-740582-1). Dep. NTIS (US Sales Only) $4.25.

From symposium on nuclear physics applied to cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

A review is given for the recent progress achieved in the study of transfer reactions induced by heavy ions. In the section devoted to the reaction mechanism, the main features of these transfer processes are discussed. The one-nucleon transfer reactions show the dependence of the transfer cross-sections on the dynamical effects. Secondly, the presence of oscillations in the angular distributions is discussed in terms of a very simple diffraction model. It shows that the transfer can be a very sensitive probe of the nuclear potential. Finally, a few examples dealing with two-nucleon transfer reactions on vibrational targets point out the contribution of two-step process. The second part of the paper deals with the analysis of experimental results. Two methods have been used, depending on the mechanism of the transfer process. The simplest case of direct transfer can be treated in the DWBA formalism; this formalism is briefly described, its predictions are compared with experiment, and it is applied to reactions involving the transfer of several nucleons. When inelastic processes become important, however, the transfer calculations require the solution of systems of coupled equations which describe the entrance and exit channels. (7 figures, 1 table) (RWR)

31571 (COO-3244-35) EXOTIC PARTICLES AS PROBES OF NUCLEAR STRUCTURE: A REVIEW. Eisenstein, R. A. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). 1974. Contract AT(11-1)-3244. 27p. (CONF-741088-1). Dep. NTIS $4.50.

From American Physical Society, Division of Nuclear Physics; Pittsburgh, Pennsylvania, USA (31 Oct 1974).

A review is given of the recent progress made toward an understanding of nuclear structure using particles as probes. Restriction is made to a review of pion-nucleus physics. The topics covered are what makes pions useful, disadvantages to pions, the pion input to nuclear structure. (JFP)

31572 (JINR-E4-8395) DENSITY-DEPENDENT EFFECTIVE NUCLEON-NUCLEON INTERACTIONS AND DIRECT NUCLEAR REACTIONS. Mikhailov, I. N.; Reif, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

The origin of the density dependence in the effective interaction between nucleons in atomic nuclei is discussed. It is shown that the density dependence brings into the nuclear models a considerable reduction of the correlations between nucleons inside the nuclear matter. The effects of this reduction are presented with an emphasis on the inelastic scattering of nucleons on nuclei. (5 figures) (auth)

31573 (JINR-P2-8569) EQUATION OF STATE FOR THE HIGHLY EXCITED AND COMPRESSED HADRONIC MATTER. Kalinkin, B. N.; Shmonin, V. L. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 10p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The possibility is considered of extracting information on the equation of state for the highly excited compressed hadronic matter using the data on the multiple production in a dense nuclear medium. (auth)

31574 (LA-5860-MS) PHONEX, A COMPUTER PROGRAM TO CALCULATE PHOTONEUTRON SPECTRA. Stamatelatos, M. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 17p. Dep. NTIS $4.00.

PHONEX is a FORTRAN-IV computer program to calculate photoneutron spectra for arbitrary energy distributions of gamma rays incident upon specific elements or materials. The photon spectrum and the photoneutron cross section as a function of the photon energy are required as input. Knowledge of the functional dependence of the double-differential photoneutron cross section on the neutron angle in the center-of-mass system is also useful. All kinematic calculations are relativistic. The spectra of both gamma rays and photoneutrons are printed and plotted as desired. (1 table) (auth)

31575 (LA-UR-75-5) MACROSCOPIC AND MICROSCOPIC APPROACHES TO NUCLEAR DISSIPATION. Davies, K. T. R.; Koonin, S. E.; Nix, J. R.; Sierk, A. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1 Jan 1975. Contract W-7405-eng-36. 15p. (CONF-750118-1). Dep. NTIS $4.00.

From international workshop III on gross properties of nuclei and nuclear excitations; Hirschegg, Kleinwalsertal, Austria (13 Jan 1975).

The macroscopic and microscopic approaches to nuclear dissipation are used to discuss uranium-236. A tentative conclusion, based primarily on the comparison between experimental fission-fragment kinetic energies and values calculated with a macroscopic approach, is that nuclei are moderately viscous with a viscosity coefficient that is about 30% of the value that is required to critically damp the quadrupole oscillations of idealized heavy actinide nuclei. (JFP)

31576 (ORO-4856-2) HIGH ENERGY EXPANSION FOR NUCLEAR MULTIPLE SCATTERING. Wallace, S. J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1975. 45p. Dep. NTIS $5.25.

The Watson multiple scattering series is expanded to develop the Glauber approximation plus systematic corrections arising from three effects: deviations from eikonal propagation between scatterings, Fermi motion of struck nucleons, and the kinematic transformation which relates the many-body scattering operators of the Watson series to the physical two-body scattering amplitude. Operators which express effects ignored at the outset to obtain the Glauber approximation are subsequently reintroduced via perturbation expansions. Hence, a particular set of approximations is developed which renders the sum of the Watson series to the Glauber form in the center-of-mass system, and an expansion is carried out to find leading-order corrections to that summation. Although their physical origins are quite distinct, the eikonal, Fermi motion, and kinematic corrections produce strikingly similar contributions to the scattering amplitude. It is shown that there is substantial cancellation between their effects and, hence, the Glauber approximation is more accurate than the individual approximations used in its derivation. It is shown that the leading corrections produce effects of order $(2kR_c)^{-1}$ relative to the double scattering term in the uncorrected Glauber amplitude, k being momentum and R_c, the nuclear charge radius. The leading-order corrections are found to be small enough to validate quantitative analyses of experimental data for many intermediate- to high-energy cases and for scattering angles not limited to the very forward region. In a Gaussian model,

the leading corrections to the Glauber amplitude are given as convenient analytic expressions. (5 figures, 1 table) (auth)

31577 (UCID-16726) NXAGMEL: A CODE TO CALCULATE CONTINUUM PHOTON AND ELECTRON PRODUCTION CROSS SECTIONS AND SPECTRA FROM NEUTRON INDUCED REACTIONS. Perkins, S. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Feb 1975. Contract W-7405-Eng-48. 20p. Dep. NTIS $4.00.

NXGAMEL is a code that calculates continuum photon (gamma rays from nuclear transitions and x-rays following internal conversion) and internal conversion electron production cross sections and spectra from neutron-induced reactions. The input, output, and recent additions to the theory, are described. (1 figure, 2 tables) (auth)

31578 (ZFK-263) BAND-MIXING AND ATTENUATION FACTORS IN ODD-MASS NUCLEI. May, F. R.; Muenchow, L. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Sep 1973. 13p. Dep. NTIS (US Sales Only) $4.00.

The concept of Coriolis coupling is derived by starting from a mixture of angular momentum-projected states. In a natural way an attenuation factor appears from the inclusion of band mixture in the basis states. (2 tables) (auth)

31579 (ZFK-264) BAND-MIXING IN EVEN–EVEN NUCLEI AND CORIOLIS ATTENUATION. Muenchow, L.; May, F. R. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Sep 1973. 10p. Dep. NTIS (US Sales Only) $4.00.

For the description of high-spin states band mixing in even–even nuclei may be essential. In a perturbation approach it is shown that the coupling is strongly attenuated; however, its inclusion is needed in order to get the Thouless moment of inertia. (auth)

31580 (ZFK-278) COUPLED CHANNEL CALCULATIONS IN THE CONTINUUM SHELL MODEL. Rotter, I.; Barz, H. W.; Wuensch, R.; Hoehn, J. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1974. 35p. (In German). Dep. NTIS (US Sales Only) $4.75.

A coupled-channels method in the framework of the continuum shell model is discussed, and the basic formulas are given. The method is a generalization of the usual shell model, including explicitly states with one particle in the continuum. It is shown that the method gives, not only the cross section of the reaction, but also the resonance parameters. The coupling between the space of the bound states and the space of the scattering states is discussed with the aid of the calculations which were performed. Further, the utility of the method in describing the scattering of nucleons on light nuclei and the reactions with absorption of γ-quanta and μ-mesons by light nuclei is shown. Several numerical results are given. (auth)

31581 NUCLEAR STRUCTURE AND HIGH–ENERGY PRODUCTION PROCESSES. Camillo, P.J.; Fishbane, P.M.; Trefil, J.S. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. Lett. 34: No. 10, 622-624 (10 Mar 1975).

Some recent studies of nuclear production processes depend critically on $\bar{\nu}$, an average number of inelastic collisions that energetic projectiles experience inside nuclei. We discuss properties and values of $\bar{\nu}$ to answer some questions rising out of recent work and facilitate comparison of the theories with experimental data. (auth)

31582 QUASIELASTIC KNOCKOUT OF CLUSTERS FROM ATOMIC NUCLEI IN THE THEORY OF MULTIPLE SCATTERING. Golovanova, N.F.; Il'in, I.M.; Neudachin, V.G.; Smirnov, Yu.F. (Nuclear Physics Institute, Moscow State University). JETP Lett. 20: No. 10, 310-311 (20 Nov 1974).

The use of the Glauber–Sitenko theory leads to new high values of the effective numbers of the d, t, and α clusters in p–shell nuclei. (auth)

31583 HIGH ENERGY DEUTERON DISSOCIATION ON NUCLEI AND CONSIDERATION OF COULOMB INTERACTION. Sitenko, A. G.; Polozov, A. D.; Evlanov, M. V. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 11, 1778-1789(Nov 1974). (In Russian).

Various diffraction processes in the interaction of high energy deuterons with nuclei are considered. Cross sections of the deuteron stripping and dissociation are calculated with taking into account the Coulomb interaction and without assuming smallness of the deuteron size as compared with the nucleus one. Significance of the diffraction and Coulomb interactions, depending on the nuclear mass number, is discussed. The calculated values are compared with the experimental data. (auth)

31584 CORRELATION EFFECTS IN L/K ELECTRON CAPTURE RATIOS. Goverse, S. C.; Blok, J. (Vrije Univ., Amsterdam). Phys. Lett. 50A: No. 2, 135-136(18 Nov 1974).

Correlation effects between the orbital electrons are suggested to be the origin of the discrepancy between the experimental and theoretical L/K electron capture ratios. (2 figures) (auth)

31585 NUCLEAR REACTIONS WITH CORE EXCITATION. Lovas, I. (Institut für Kernphysik, Kernforschungsanlage Jülich, D–5170 Jülich, W.–Germany). Ann. Phys. (N.Y.) 89: No. 1, 96-114 (Jan 1975).

The transition amplitudes for nucleon scattering, stripping, pick–up, and break–up reactions are derived in the framework of a three–body model. The model consists of two nucleons and a core. The core is assumed to have a discrete excitation spectrum. The nucleon–core interactions give rise to the excitation and subsequent deexcitation of the core. The energy-averaged transition amplitudes are obtained by iteration from Faddeev–type integral equations. The lowest-order terms correspond to the DWBA and the higher-order terms described the multistep processes. (auth)

31586 THE EFFECT OF COMPOUND STATES ON COLLECTIVE–STATE SINGULARITIES IN THE OPTICAL POTENTIAL. Hahne, F.J.W.; Heiss, W.D. (Atomic Energy Board, Pelindaba, Transvaal, South Africa). Ann. Phys. (N.Y.) 89: No. 1, 68-95 (Jan 1975).

From an exact form of the self–energy of a nucleon in a nucleus, which is equivalent to the optical potential, two approximation schemes, which are both based on a weak-coupling picture, are presented. They lead to expressions which can be interpreted physically as the coupling of a dressed single–particle (single–hole) state to the exact particle–hole (particle–particle) propagator. The residues of the many pole of the self–energy are divided into two categories: (i) residues which are distributed statistically, and (ii) residues which vary systematically. The first set is interpreted as compound nuclear structure, and its influence on the single-particle motion is investigated. The second set leads to intermediate structure. This structure is further investigated within an extension of the random phase approximation where all particle and hole lines are dressed by compound nuclear effects. In this way the spreading width of intermediate resonances, which is found to be the imaginary part of the pole position in the self–energy, is calculated. The escape width for these resonances is obtained by solving the Lippmann–Schwinger equation in which the calculated self–energy appears. This width depends on the structure of the continuum as well as the residues of the poles of the self–energy. It is shown that these residues are complex, one of the reasons for this being that corrections to the vertex for the excitation of a collective state, appear. The similarity between the complex form factors introduced in the macroscopic model for inelastic scattering and the complex vertex functions above, is discussed. It is also pointed out that the results obtained here may be used in a phenomenological analysis. (auth)

31587 EXCHANGE EFFECTS FROM WEAK RADIATIVE MESONIC TRANSITIONS IN PARITY–VIOLATING NUCLEAR PROCESSES. Herczeg, P. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Singer, P. Phys. Rev. D 11: No. 3, 611-619 (1 Feb 1975).

We calculate the exchange contributions to parity–violating nuclear electromagnetic processes resulting from the weak–electromagnetic transitions $M \rightarrow \pi\gamma$, where M is a set of vector and axial–vector mesons. The amplitudes $M \rightarrow \pi\gamma$ are studied in the framework of a pole model. Their contribution to the circular polarization of photons in the $n + p \rightarrow d + \gamma$ reaction is estimated and found to be smaller by an order of magnitude or more than the contribution due to admixtures of opposite–parity n–p states. (auth)

31588 NUCLEAR MOMENTS OF INERTIA AND THE VMI LAW. Scharff-Goldhaber, G. (Brookhaven National Lab., Upton, N. Y. (USA)); Goldhaber, A. S. (State Univ. of New York, Stony Brook (USA)). v.2 p.182-185 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

For the ground-state bands of most even–even nuclei, the two-parameter Variable Moment of Inertia (VMI) law defines an effective moment of inertia I(J), using only the spectrum (E_2, E_4). Even for those nuclei for which I(0) = 0, I(2) is always positive. The "average" moment of inertia $I_{02} = [I(0) + I(2)/2]$ may thus be related to the transition quadrupole moment $Q_{02} = [16\pi/5\ B(E2)\ (0 \rightarrow 2)]$. It is shown that $I \propto Q^2$. (auth)

31589 COLLECTIVE ASPECTS OF THE SHELL MODEL. Iachello, F. (Rijksuniversiteit Groningen (Netherlands). Kern-

physisch Versneller Instituut). v.2 p.163-181 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.), Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Collective nuclear excitations of vibrational states are treated in the shell model framework. The single-particle Hamiltonian can be calculated using techniques such as the boson expansion method and the interacting boson model. A formula is derived and used to calculate the energy levels of ^{102}Pd, ^{148}Sm, and ^{154}Dy. Good agreement with experiment is obtained. (NL)

31590 HARTREE FOCK CALCULATIONS. Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). v.2 p.127-159 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Applications of the HF approach to "non-trivial" experimental data are presented. HF methods are applied to μ^--mesic atoms, the μ^- meson being handled as one of the self-consistent particles which influences and polarizes the charge distribution of the protons. HF solutions with a constraint on the radius are employed as generator functions in the generator coordinate method to describe the (isoscalar) breathing mode state. Density-dependent forces are utilized to calculate the giant multipole resonances. One starts with a HF calculation for the singie-particle properties and calculates, with the same force, in the random phase approximation the position of the resonances. The constrained Hartree–Fock–Bogolyubov (HFB) approach is used to generate functions to be used to describe low-lying vibrational and rotational spectra within the generator coordinate method. An attempt is made to justify and to derive effective density-dependent forces directly in finite nuclei. (auth)

31591 TRUNCATION SCHEMES IN SHELL MODEL SPACES. Zuker, A. P. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Centre de Recherches Nucleaires). v.2 p.115-126 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Truncation procedures reflect the belief that nuclear degrees of freedom and their interplay can be represented by smaller linear spaces spanning selected configurations of few shell model orbits. Truncation schemes based on perturbation theory and on weak-coupling are presented. The problem that a very simple model involving only $p_{\frac{1}{2}}$, $s_{\frac{1}{2}}$, and $d_{\frac{5}{2}}$ orbits is able to account so well for nearly all the known levels in the region A = 15 – 18 is discussed. (NL)

31592 CONTINUUM RANDOM-PHASE CALCULATIONS OF GIANT RESONANCES. Krewald, S.; Faessler, A.; Speth, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Birkholz, J. (Technische Univ. Darmstadt (F. R. Germany). Fachgebiet Theoretische Kernphysik). v.2 p.111-114 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Microscopic calculations of higher multipole giant resonances including a determination of the widths are presented. A random-phase wavefunction which takes into account the evaporation of particles into the continuum has been used. Giant dipole, quadrupole and octupole resonances are calculated for ^{16}O and ^{40}Ca. (auth)

31593 EFFECTIVE INTERACTIONS IN NUCLEI. Weidenmueller, H. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). v.2 p.1-19 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

In phenomenological shell-model calculations, one puts the valence nucleons into a set of nearly degenerate shell-model orbitals, chooses some parametric form of the residual interaction, and diagonalizes the Hamiltonian matrix thus introduced. The resulting spectrum is compared with the observed one. The convergence of the perturbation expansion for the effective interaction is considered. It is found that the method of Padé approximants gives good approximations in low order. (auth)

31594 CONVERGENCE PROPERTIES OF EFFECTIVE INTERACTION EXPANSIONS IN A MODIFIED LIPKIN SOLVABLE MODEL. Anastasio, M. R.; Kuo, T. T. S. (State Univ. of New York, Stony Brook (USA)); Osnes, E. (Oslo Univ. (Norway)). v.2 p.20-23 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Several methods now exist to compute the effective interaction in open-shell nuclei. The convergence properties of several of these methods are tested by using a model which has exact solutions that are easily obtained. The methods discussed are the term-by-term summation of the folded-diagram series and the sequence of partial summations of the folded-diagram series. (auth)

31595 DENSITY DEPENDENT INTERACTIONS AND NUCLEAR STRUCTURE. Zamick, L. (Rutgers — The State Univ., New Brunswick, N. J. (USA). Dept. of Physics). v.2 p.24-49 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The Hartree–Fock equation is solved by using harmonic oscillator wave functions for the single-particle wave functions and a delta interaction for the residual interaction. To improve the results a repulsive density-dependent interaction is then included. Density-dependent interactions are compared with other interactions which also give saturation to determine whether density-dependent interactions are necessary for nuclear structure calculations. (NL)

31596 ARE DENSITY DEPENDENT EFFECTIVE INTERACTIONS NEEDED IN NUCLEAR SPECTROSCOPY? Vichniac, G. Y.; Schaeffer, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). v.2 p.50-53 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Some connections between the tools of Hartree–Fock theorists and needs of shell-model theorists are pointed out, and the question "Are density-dependent effective interactions needed in nuclear spectroscopy?" is considered. It is proposed that one can get the effective interaction v_s correctly by taking into account the density dependence of Brueckner's G matrix. It is suggested that i) the density dependence of the effective interaction is essential for getting the right magnitude of the T = 0 and T = 1 splitting; ii) the change in the range should be examined carefully when density dependence is introduced.. (auth)

31597 HOW REALISTIC ARE CALCULATIONS WITH REALISTIC FORCES? Kirson, M. W. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). v.2 p.54-68 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The concept of a realistic force is generally taken to refer to one which is directly related to the free nucleon–nucleon interaction, as determined in experiments on the two-nucleon system. Given a free nucleon–nucleon interaction, the realistic force for a given calculation should follow immediately, with no arbitrary free parameters. In order to be realistic, the calculation must be firmly and clearly based on fundamental theory, and must reflect the empirically established features of nuclear structure. By comparing experimental and theoretical results, it is concluded that very few calculations with realistic forces satisfy both these criteria. (auth)

31598 GIANT RESONANCES. Hanna, S. S. (Stanford Univ., Calif. (USA). Dept. of Physics). v.2 p.249-285 of Proceedings of the International Conference on Nuclear Structure and Spec-

troscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The three basic properties of a "giant" resonance are discussed: its systematic location in all nuclei, its great strength in terms of an appropriate sum rule, and its concentration in a rather narrow region. A brief review of these properties for the giant E1 resonance, which are not well established, is given; and the existing knowledge on M1 resonances and E2 strength, both isoscalar and isovector, is surveyed. The interesting E0 resonances are discussed only from the point of view of isolating them from the E2 resonances. (auth)

31599 DEEPLY BOUND HOLE STATES. Jackson, D. F. (Surrey Univ., Guildford (UK)). v.2 p.396–411 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Deeply bound hole states are formed when one or more nucleons are removed from an inner shell. Here, the discussion will be restricted to single hole states which may be formed through knock-out reactions, such as (p,2p) and (e,ep), transfer reactions such as (p,d) and (d,t), or by the photonuclear processes (γ,p) and (γ,n). By means of the excitation of these deeply bound states, the following aspects of nuclear structure are studied: (i) the extent to which shell structure persists for tightly bound nucleons in heavy nuclei, the location and the population of any identifiable single-particle states, the connection between this information and nuclear models; (ii) the momentum distribution of tightly bound nucleons, the extent to which the low-momentum components are compatible with predictions from single-particle models, the importance and interpretation of high-momentum components; (iii) the splitting and spreading of the single hold strength, the interpretation of this in terms of the coupling of the single hole "doorway" state to successive n hole–(n–1) particle states, the connection of the spreading width with many-body theories. (auth)

31600 INELASTIC SCATTERING AND CHARGE EXCHANGE. Schaeffer, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). v.2 p.318-340 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Inelastic scattering of light particles (protons, deuterons, helions, tritons, and alpha particles) and the (p,n) or (h,t) charge exchange reactions at low energies (say, E < 100 MeV) are considered. These reactions are believed to be described as a slight perturbation of elastic scattering. Differential cross sections are calculated for these reactions. (auth)

31601 SINGLE AND MULTI-NUCLEON TRANSFER REACTIONS. Fortune, H. T. (Argonne National Lab., Ill. (USA)). v.2 p.341-387 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

There are at least three structure properties of a nuclear level that are, in principle, obtainable from transfer reactions: 1) angular momentum, 2) parity, and 3) overlap of the actual wave function with some model wave function. Examples of all three are given. Many of the points under discussion are illustrated by examples from light nuclei. In most transfer reactions, the shape of the angular distribution determines the orbital angular momentum of the transferred particle or cluster. Spectroscopic factors and spins are also determined. (auth)

31602 OVERLAP FUNCTIONS AND SUM RULES. Clement, C. F. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). v.2 p.420-433 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The single-particle properties of nuclei are discussed. The need to determine accurate single-particle spectroscopic factors and the uses of spin-dependent sum rules for spectroscopic factors are considered. Since the degree to which the latter are fitted to experimental data is characterized by the relative error, σ, in spectroscopic factors, the two aspects are intimately related. The present status of the subject is summarized and some of the many possible future lines of work are mentioned. There is already a vast amount of data on spectroscopic factors, but an essential constituent, namely a reliable j quantum number, is generally still missing. The need to fill this experimental gap is emphasized. (auth)

31603 NUCLEAR GAMMA AND BETA DECAY. Lawson, R. D. (Argonne National Lab., Ill. (USA)). v.2 p.464–484 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Some aspects of nuclear beta and gamma decay are discussed, and the places where additional experimental information or where theoretical problems still exist are stressed. The material is divided into two parts: first, those rules which are geometrical in origin are discussed, and, second, results arising from isospin are considered. It is shown that a measurement of the $^{203}_{81}Tl_{122}$ beta decay to the $\frac{1}{2}^+$ state in $^{203}_{82}Pb_{121}$ could yield important information about a possible difference in the radii of the neutron and proton single-particle potential wells. Further, the problem of the anomalously fast ΔT = 0 E1 transitions in 4n nuclei is discussed. (auth)

31604 ELECTROMAGNETIC AND WEAK INTERACTIONS WITH NUCLEI. Walecka, J. D. (Stanford Univ., Calif. (USA). Inst. of Theoretical Physics). v.2 p.438–456 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Semi-leptonic electromagnetic and weak interactions with nuclei are discussed. There are two reasons why electron scattering is a valuable tool for studying nuclear structure. The first is that the interaction is known, as the electron interacts electromagnetically with the local charge and current density in the target. Since this interaction is relatively weak, of order α, one can make measurements without greatly disturbing the structure of the target. The second advantage is that, for a fixed energy loss to the target, one can vary the 3-momentum transfer and map out the Fourier transforms of the static and transition densities; by inverting, one has a microscope for localizing the densities themselves. Neutrino reactions are also considered. (auth)

31605 SUPERALLOWED $0^+ \rightarrow 0^+$ NUCLEAR β-DECAYS AND CHARGE DEPENDENT MIXING. Hardy, J. C.; Andrews, H. R.; Ball, G. C.; Geiger, J. S.; Graham, R. L.; Macdonald, J. A.; Schmeing, H.; Towner, I. S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). v.2 p.485-488 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The ft-values of all superallowed β transitions between 0^+ (T = 1) analogue states should be equal, regardless of the specific nuclei involved, provided that small radiative corrections and charge-dependent effects are properly accounted for. Since this is a model-independent prediction of the conserved vector current (CVC) hypothesis, the approximate equality of measured ft-values for such transitions has long been taken as supportive evidence for the validity of CVC. On the other hand, in accepting this experimental evidence, discrepancies of the order of a few percent from equality had to be ignored because of uncertainties in charge-dependent mixing for the nuclei involved. At Chalk River a systematic study of $0^+ \rightarrow 0^+$ superallowed transitions has been undertaken with a view to examining both the validity of CVC and the actual effects of nuclear charge dependence. (auth)

31606 EFFECTIVE CHARGES. Brussaard, P. J. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). v.2 p.489-505 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Despite the increasing sizes of shell model spaces, one still

needs effective charges and effective g-factors to reproduce the experimental data on electromagnetic moments and transition rates. This effective charge can be interpreted easily in a semi-classical description. Due to the residual nucleon–nucleon interaction, the extra-core nucleon polarizes the ^{16}O core and it thus induces an electric moment of the core. Hence, when the active nucleon makes the transition, it is in fact the induced moment of the core that is responsible for the observed enhancement of the E2 gamma emission. Two methods of determining effective charges are considered, one using harmonic oscillator wave functions, and the other using perturbation theory. (auth)

31607 COULOMB ENERGY DIFFERENCES. Negele, J. W. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). v.2 p.618-640 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

One of the essential complications of the nuclear many-body problem is the simultaneous uncertainty of the nature of the nucleon–nucleon interaction and the structure of the nuclear wave function. Hence, Coulomb effects in nuclei are particularly significant since in principle they offer the possibility of separating the known Coulomb interaction from the ambiguities of the wave function and thus extracting specific information regarding the nuclear wave function. In recent years, therefore, considerable attention has been devoted to the interpretation of energy differences between mirror pairs of light nuclei and displacement energies of isobaric analog states in heavy nuclei with the hope of obtaining an unambiguous determination of the spatial distribution of neutron wave functions. Unfortunately, it now appears that this hope is in vain. Coulomb energy differences are much more complicated than originally anticipated, and the attempt to use them to explore the neutron wave function is seriously limited by the present experimental and theoretical ignorance concerning charge asymmetry in the nuclear force. (auth)

31608 MAGNETIC MOMENTS OF NUCLEAR STATES. Yamazaki, T. (Tokyo Univ. (Japan). Dept. of Physics). v.2 p.554-575 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Magnetic moments in the closed-shell regions are discussed from the empirical viewpoints: 1) additivity, 2) effective one-body operator, 3) core polarization mechanism, and 4) meson effects. (auth)

31609 CHARGE DEPENDENT MIXING. Adelberger, E. G. (Washington Univ., Seattle (USA)). v.2 p.641-661 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

There are two main issues which underlie the interest in charge-dependent mixing: (1) to understand the mechanism by which electromagnetic forces alter the properties of nuclear states; (2) to investigate the charge dependence of the basic interactions, such as the nucleon–nucleon force, the weak force or the electromagnetic field. The topics discussed are as follows: (1) the effect of CD distortion on β, γ, and particle reaction rates involving low-lying states, (2) isospin mixing in ^{8}Be and ^{12}C, (3) isospin mixing in $T = {}^{3}/_{2}$ states. (auth)

31610 NUCLEAR GROUND-STATE PROPERTIES AND SELF-CONSISTENT CALCULATIONS WITH THE SKYRME INTERACTION. I. Spherical Description. Beiner, M.; Flocard, H.; Nguyen Van Giai; Quentin, P. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 238: No. 1, 29-69(27 Jan 1975).

The parameters of the effective Skyrme interaction are determined by requiring that they accurately reproduce the total binding energies and charge radii of magic nuclei in spherical self-consistent calculations. It is shown that many parameter sets can satisfy these requirements. They differ essentially by the single-particle spectra they give. A detailed study of the influence of the force parameters on the binding energies, charge densities, radii and single-particle energies of magic nuclei is made. Extensive self-consistent calculations covering over two hundred nuclei have been performed in a spherical scheme using one of the parameter sets. The effects of pairing correlations are discussed. The magnitude of the corrections due to the deformation in the rare earth region is indicated. The good overall agreement of the results with experimental data shows that the Skyrme parametrization of the effective interaction is adequate. The remaining discrepancies may be attributed essentially to dynamic collective effects not included in the present approach. (auth)

31611 PERTURBATION THEORY FOR PROJECTED STATES IN THE PAIRING FORCE MODEL. II. The Problem Of Convergence. Atalay, B. I. (Institute for Advanced Study, Princeton, N. J. (USA)); Mann, A. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). Nucl. Phys., A; 238: No. 1, 70-78(27 Jan 1975).

In a previous paper second-order calculations were carried out on the two-level pairing force model using perturbation theory for projected states and the results were compared with those of BCS or ordinary perturbation theory. In the present paper criteria for convergence are applied to two different forms of the perturbation series for both the projected and ordinary perturbation theories. It is found that the superior results obtained for the convergence rates in the projected theory tally neatly with the results of the second-order calculations, and give further support to the use of the projected perturbation theory. (auth)

31612 CONVERGENCE PROPERTIES OF EFFECTIVE INTERACTION EXPANSIONS IN A MODIFIED LIPKIN MODEL. Anastasio, M. R.; Kuo, T. T. S. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Nucl. Phys., A; 238: No. 1, 79-92(27 Jan 1975).

The convergence properties of three methods for constructing the effective interaction are studied by comparing them to the exact solutions of a two-level Lipkin model modified for open-shell nuclei with a one-dimensional model space. The methods considered are the Bloch–Horowitz equation, the folded-diagram series of Kuo et al., and the sequence of partial summations of the folded-diagram series. A criterion for the maximum region of convergence of both the folded-diagram series and the sequence of partial summations is established in terms of the overlap of the exact and model-space wave functions. The sequence of partial summations is found to be more convenient for calculations than the folded-diagram series. (auth)

31613 ON THE FORMALISM OF KNOCK-OUT REACTIONS. Nakano, K. (Victoria Univ., British Columbia (Canada). Dept. of Physics). Phys. Lett., B; 53: No. 5, 413-416(6 Jan 1975).

A different approach to knock-out reactions is presented. A new equation of a distorted wave theory is obtained as well as the ordinary DWTA equation. Also obtained is an exact formal solution for the distorted wave theory. (auth)

31614 ISOBAR MIXING AND COULOMB DISPLACEMENT ENERGIES IN NUCLEI. Auerbach, N. (Brookhaven National Lab., Upton, N. Y. (USA)). Phys. Lett., B; 53: No. 5, 417-418 (6 Jan 1975).

It is pointed out that, because of the electromagnetic mass splitting of members of a nucleon isobar multiplet (such as the Δ_{33}), admixtures of this isobar in nuclei may lead to substantial corrections in nuclear Coulomb displacement energies. (auth)

31615 MULTISTEP EXCITATION IN COHERENT NUCLEAR PRODUCTION PROCESSES. Faeldt, G. (Lund Univ. (Sweden). Institutionen foer Teoretisk Fysik med Mekanik); Osland, P. (Trondheim Univ. (Norway). Norges Laererhoegskole). Phys. Lett., B; 53: No. 5, 419-424(6 Jan 1975).

An interesting method of observing the existence of two-step excitation in nuclear production processes by analyzing coherent low-energy experiments with D and He targets is suggested. The calculation of production cross sections is done by using Glauber theory and assuming that the 3π–nucleon cross section is equal to the pion–nucleon cross section. (auth)

31616 ANALOG SPIN WAVE FUNCTIONS AND SPREADING WIDTHS OF ISOBARIC ANALOG RESONANCES. MacDonald, W. M.; Auerbach, N. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Phys. Lett., B; 53: No. 5, 425-428(6 Jan 1975).

The coupling of the isobaric analog state (IAS) to the giant isovector monopole state has been shown by Mekjian and Auerbach to affect the calculation of the spreading width dramatically. It is shown that the inclusion of this coupling is equivalent to a new definition of the IAS as an eigenstate of analog spin in which each proton radial wave function is distorted relative to the corresponding neutron radial wave functions by the central Coulomb field. (auth)

31617 PADE APPROXIMANTS AND THE EFFECTIVE SHELL MODEL INTERACTION. Lee, T. S. H.; Pittel, S. (Bartol Research Foundation, Swarthmore, Pa. (USA)). Phys. Lett., B; 53: No. 5, 409-412(6 Jan 1975).

A scheme for approximating the effective interaction in the presence of an intruder state is discussed. The method, which employs the Padé approximation for individual matrix elements in an appropriately transformed basis, is shown to be reliable for a 3 × 3 Hamiltonian matrix. (auth)

31618 EXACT FINITE RANGE DWBA CALCULATIONS FOR HEAVY-ION INDUCED NUCLEAR REACTIONS. Tamura, T.; Low, K. S. (Texas Univ., Austin (USA). Center for Nuclear Studies). Comput. Phys. Commun.; 8: No. 5, 349-376(Dec 1974).

The package SATURN-MARS-1 consists of two programs SATURN and MARS for calculating cross sections of reactions transferring nucleon(s) primarily between two heavy ions. The calculations are made within the framework of the finite-range distorted wave Born approximation (DWBA). The first part, SATURN, prepares the form factor(s) either for exact finite-range (EFR) or for no-recoil (NR) approach. The prepared form factor is then used by the second part, MARS, to calculate either EFR-DWBA or NR-DWBA cross sections. (auth)

31619 BOUND STATES OF ONE NUCLEON IN A WOODS–SAXON WELL FROM A VARIATIONAL METHOD. Delbrouck-Habaru, J. M.; Dubois, D. M. (Liege Univ. (Belgium)). Comput. Phys. Commun.; 8: No. 5, 396-403(Dec 1974).

The program computes the wave function characterized by an orbital angular momentum L for the bound states with $J = L + \frac{1}{2}$ and $J = L - \frac{1}{2}$ of a particle in a Woods-Saxon potential with spin-orbit coupling. The solution of the radial Schrodinger equation for a particle in a Woods-Saxon potential is developed on a complete set of orthonormal wave functions ϕ_{NL}, solutions of the radial Schrodinger equation for the harmonic oscillator potential, in the framework of Tobocman and Nagarajan's variational method. (auth)

31620 THREE-NUCLEON TRANSFER FOR THE 1p SHELL. Kurath, D.; Millener, D. J. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Phys., A; 238: No. 2, 269-286(3 Feb 1975).

Parentage amplitudes for transfer of a $(1p)^3$ group with spatial symmetry [3] are given for 1p shell targets with initial and final states represented by intermediate-coupling wave functions. Some examples of interference from $(1p)(2sd)^2$ transfer are given for the upper end of the shell. The selectivity and distribution in energy of such transfer is discussed. (auth)

31621 CLASSICAL DYNAMICAL THEORY OF HEAVY ION FUSION AND SCATTERING. Bondorf, J. P. (Niels Bohr Institutet, Copenhagen (Denmark)); Sobel, M. I.; Sperber, D. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Phys. Rep.; 15: No. 2, 83-111(Dec 1974).

A classical dynamical model which includes dissipative forces is suggested for heavy ion reactions high above the Coulomb barrier. Internal degrees of freedom corresponding to rotation of the ions are included. The reactions divide into three parts: (1) quasi-elastic scattering, with relatively small energy loss, associated with higher angular momenta, (2) deep inelastic scattering, with larger energy loss and considerable transfer of mass, associated with intermediate angular momenta, and (3) complete fusion where a highly excited compound state is formed, generally associated with the lowest angular momenta. One can predict a fusion cross section for two values of the friction coefficient, "weak" and "strong" friction cases. Reasonable values for fusion can be obtained in the weak friction case, but scattering angular distributions are not consistent with available experimental data. In the strong friction case it is more difficult to fit all the fusion cross sections with a single friction parameter, but the predicted angular distributions and energy losses are in better agreement with experiment than for the weak friction case. (auth)

31622 SUCCESSES AND FAILURES OF THE NUCLEAR SHELL MODEL McGrory, J. B. (Oak Ridge National Lab., Tenn. (USA)). v. 2 p. 73-106 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9-13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The successes and failures of shell models in describing systematic patterns of nuclear phenomena are considered. Theory–experiment comparisons are made for energy levels, electromagnetic moments, electromagnetic transition rates and two-nucleon transfer cross sections. The application of the conventional shell model to states which involve core-excitation around ^{16}O and ^{40}Ca is described. (NL)

31623 TWO-STEP PROCESSES IN TRANSFER REACTIONS. Rost, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Theorique; Colorado Univ., Boulder (USA)). J. Phys. (Paris), Colloq.; No. 5, 61-65(1974).

From symposium on nuclear physics with cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

The inclusion of two-step processes in the distorted wave analysis is directed-reaction experiments is discussed. It is shown that such effects can be important for heavy ions, for high energy projectiles and for the analysis of weak transitions. The two-step reaction mechanism can confuse the extraction of spectroscopic information from experiment but in certain cases the coherent nature of the one-step, two-step interference can provide spectroscopic phase information not otherwise available. (FR)

31624 NUCLEUS AT 70+. Wilkinson, D. (Oxford Univ.). Phys. Bull. (London); 25: 578-579(Dec 1974).

The nucleus remains a mystery although it is more than 70 years since its discovery. It is suggested that the nucleus of ^{208}Pb, for example, should be considered as consisting of 82 free protons and 126 free neutrons with an unknown number of pions. It is no longer possible to split the system uniquely into neutrons, protons and mesons in flight; the nature and substance of the particle is affected by its interaction. When, in a complex nucleus, a pion is emitted from one nucleon and absorbed by another, the receiving nucleon on absorbing the pion may very well be raised into an excited isobaric state, call it generally N*, as may also the despatching nucleon on emitting the pion. It is shown that the probability of any given nucleon in a complex nucleus being in an excited isobaric N* state is 1 to 2%. The existence of the N* component opens up a new vista of nuclear structure physics. A spate of experiments to detect N* has begun. (UK)

31625 HYPERNETTED-CHAIN APPROXIMATION FOR A FERMION SYSTEM. Fantoni, S.; Rosati, S. (Univ., Pisa, Italy). Nuovo Cim.; 25A: No. 4, 593-615(21 Feb 1975).

An iterative procedure is presented to exactly calculate the two-body distribution function of an infinite fermion system described by a Jastrow wave function of general product form. In the approximation of neglecting the elementary diagrams the procedure leads to integral equations which are the analogs of the well known hypernetted-chain equation for the boson case. Preliminary numerical calculations were performed for the ground state of nuclear matter using central, hard-core N–N potentials; the results obtained seem to indicate the necessity of using the fermion HNC approximation even at nuclear densities. (auth)

31626 SINGULARITIES IN THE GALITSKII–FEYNMAN T MATRIX. Bishop, R. F.; Strayer, M. R.; Irvine, J. M. (Univ. of Manchester, Eng.). Phys. Rev., A; 10: No. 6, 2423-2429(Dec 1974).

The Galitskii–Feynman T matrix, which sums the ladder diagrams for both particle–particle and hole–hole scattering in a many-fermion system, is shown to have a singularity at negative values of the cm energy of the interacting pair. The singularity appears as a first-order pole in the T matrix, the position of which is a function of both the density of the system and the total cm momentum of the pair, and corresponds to the formation of bound pairs in the medium. The singularity structure exists in two distinct Fermi systems (liquid ^3He and nuclear matter), and detailed numerical results are presented with use of a potential appropriate to liquid ^3He. The singularity in this case is shown to be present at all densities above a certain critical density which is lower than the physical density. (3 figures) (auth)

31627 WEAK COUPLING. Heyde, K. (Ghent Rijksuniversiteit (Belgium)). v.2 p.186-211 of Proceedings of the International Conference on Nuclear Structure and Spectroscopy, Amsterdam, September 9–13, 1974. Nuclear Models in Theory and Experiment. Blok, H. P.; Dieperink, A. E. L. (Eds.). Amsterdam; Scholar's Press (1974).

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The weak coupling between single-particle and collective surface vibrational motion is considered. The meaning of weak coupling and its region of validity are defined, and some application is made to results obtained from proton inelastic scattering through isobaric analogue resonances (IAR) in the region of single-closed-shell nuclei with N = 82. Here, a direct experimental test on the validity of the weak-coupling description is observed. A region of current interest is the odd-proton $_{49}In$ isotopes, where open problems still exist concerning coexistence of spherical and deformed states in the same nucleus. Recent theoretical results from the Alaga group, obtained by comparing diagonalization and results from a diagrammatic approach concerning the coupling of two or three particles (holes) to the vibrational motion, are discussed. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 29894, 30818, 30819, 31317, and 31321.

31628 (AED-CONF-74-509-016) ATOMIC RECOILS, QUASI-ELASTIC SCATTERING AND RADIATION DOSIMETRY. Watt, D. E.; Sutcliffe, J. F. (Dundee Univ. (UK). Dept. of Medical Biophysics). 1974. 7p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

The established importance of quasi-elastic scattering processes by heavy recoils, of the type released by intermediate energy neutron interaction with tissue-like media, necessitates re-examination of current dosimetry concepts. It is shown that theoretical and experimental examination of cross-sections for molecular inactivation by H, He and n projectiles at energies below 10 keV permit useful conclusions to be reached about the primary inactivating mechanism. The implications with regard to overkill, radiation quality and dosimetry generally is discussed in terms of the fundamental cross sections. (auth)

31629 (CEA-R-4615) APPLICATION OF THE MONTE CARLO METHOD TO THE SIMULATION OF ELECTRON TRAJECTORIES IN THICK TARGETS IN THE RANGE 10 TO 30 keV. Henoc, J.; Maurice, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Feb 1975. 176p. (In French). Dep. NTIS (US Sales Only) $12.00.

Microprobe analysis requires the knowledge of the distribution in depth of characteristic x-ray emission. This distribution which is rather difficult to determine by means of experiments may be obtained through the simulation of electron trajectories by the Monte-Carlo method. A more realistic approach than that commonly used is described by replacing the concept of mean energy losses by the statistical treatment of energy losses according to Landau. The results of the two models are compared with the experimental evidence. (auth)

31630 (CONF-740940-20) STUDIES OF ENERGY DEPOSITION BY NEUTRONS. Caswell, R. S.; Coyne, J. J.; Randolph, M. J. (Oak Ridge National Lab., Tenn. (USA); National Bureau of Standards, Washington, D. C. (USA)). [nd]. 21p. Dep. NTIS $4.25.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, F. R. Germany (30 Sep 1974).

Neutrons generate secondary particles (p, α, C, N, O, etc.) when they interact with tissue. It is through these secondary particles that nearly all of the energy deposition and biological effects occur. It is therefore of interest to determine the total energy transferred to the charged particles (kerma), the initial spectrum of the secondary particles, the slowing-down spectrum, and the details of the energy deposition by these secondary charged particles. Kerma calculations and some studies of the energy deposition in spherical volumes are discussed. (MHR)

31631 (CONF-741109-4) PHYSICAL PRINCIPLES OF PHOTON DOSIMETRY. Snyder, W. S.; Ford, M. R. (Oak Ridge National Lab., Tenn. (USA)). 1974. 18p. Dep. NTIS $4.00.

From international symposium on radiation physics; Calcutta, India (30 Nov 1974).

Dose from sources of photons within the body is considered because the short range of electrons and alpha particles reduces the complexity of estimation of average dose to an organ. It is this concept of average dose in an organ or tissue that is considered throughout. Here the attempt is to focus on what has been learned about dosimetry in a complex phantom resembling in some respects the human body. An idealized mathematical model of the human body was developed to use for Monte Carlo type calculations of photon dose. Attention here is restricted to physical results or principles which are a by-product of the studies. (MHR)

31632 (CONF-750303-3) BIOMEDICAL RADIATION TRANSPORT CALCULATIONS AS AN APPLICATION OF NUCLEAR DATA. Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 7p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The extent to which transport calculations of biomedical interest for negatively charged pions, neutrons, protons, alpha particles, and heavier ions can presently be performed is reviewed. (auth)

31633 (CONF-750303-38) RADIATION SHIELDING INFORMATION CENTER DATA ACTIVITIES. Roussin, R. W.; Maskewitz, B. F.; Trubey, D. K. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Activities developed at the Radiation Shielding Information Center (RSIC) play an important role in the utilization of nuclear cross sections in various radiation transport applications and help improve the general utility of the national ENDF/B effort. The activities involving processed and evaluated data libraries on behalf of RSIC's various sponsoring agencies are described. (2 tables) (auth)

31634 (JINR-P14-8295) USE OF THE $^{10}B(n,\alpha)^{7}Li$ REACTION FOR THE DETERMINATION OF THE RANGE OF BORON IONS IMPLANTED IN SILICON. Boganch, Ya.; Deme, Sh.; Dyulai, I.; Nagy, A.; Nazarov, V. M.; Cheke, A.; Yazvitskii, Yu. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 17p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

A nondestructure technique for the determination of the ranges of boron ions implanted in silicon is briefly described. The values of the boron ranges in silicon in the implantation energy region 20 to 80 keV were determined with an accuracy of ±200 Å. The values obtained are compared to LSS theory and to other experiments. (5 figures, 1 table) (auth)

31635 (LBL-3219) MEASUREMENT CONSIDERATIONS: DOSIMETRY. Thomas, R. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 24 Oct 1974. Contract W-7405-eng-48. 47p. Dep. NTIS $5.50.

Definitions of dosimetry are discussed. An attempt is made to understand the differences between the concepts of exposure, absorbed dose, and dose equivalent, with their respective units, the roentgen, the rad, and the rem. Natural background radiation is discussed at length. Radiation monitoring is discussed including the use of such detection instruments as: ionization chambers, scintillation counters, gamma spectrometers, and thermoluminescent detectors. (MHR)

31636 (SAND-74-0030) CYLTRAN: A CYLINDRICAL-GEOMETRY MULTIMATERIAL ELECTRON/PHOTON MONTE CARLO TRANSPORT CODE. Halbleib, J. A. Sr.; Vandevender, W. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 32p. Dep. NTIS $4.75.

CYLTRAN provides experimenters and theorists with a method for the routine solution of coupled electron/photon transport through multi-material configurations possessing cylindrical symmetry. Emphasis is placed upon operational simplicity without sacrificing the rigor of the model. CYLTRAN combines condensed-history electron Monte Carlo with conventional single-scattering photon Monte Carlo in order to describe the transport of all generations of particles from several MeV down to 1.0 and 10.0 keV for electrons and photons, respectively. The model is more accurate at the higher energies, with a less-rigorous description of the particle cascade at energies where the shell structure of the transport media becomes important. Flexibility of construction permits the user to tailor the model to specific applications and to extend the capabilities of the model to more sophisticated applications through relatively simple update procedures. (auth)

31637 (TID/SNA-134) TECHNICAL REPORT AND USER'S MANUAL. DASH - FORTRAN IV: Void Tracing and S_n -Monte Carlo Bridging Code. Lindstrom, D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 52p. Dep. NTIS $5.75.

DASH is a FORTRAN IV program designed to process surface angular fluxes generated by the two-dimensional discrete ordinates code, DOT. Using angular fluxes stored on tape by DOT from a cylindrical geometry calculation, DASH calculates angular fluxes on arbitrary cylindrical geometry surfaces outside the DOT boundaries. The calculation is carried out by a numerical integration of angular fluxes employing a single-event Monte Carlo routine. Particle traces are generated by random sampling of the S_n angular flux histograms or of power series fits to the S_n information. This employment of random sampling avoids the "ray effects" that would occur if DOT were extended to include void or pure absorber regions. Since flux information internal to

DASH has a Monte Carlo format and can be collected into the tables appropriate to an S_n calculation, DASH can be used as a coupling code. Source information can be input to DASH in either S_n or Monte Carlo format, and either format can be output for use as source information for a following coupled code. (MHR)

31638 MONTE CARLO SIMULATION OF ENERGY DEPOSITION BY LOW-ENERGY ELECTRONS IN MOLECULAR HYDROGEN. Heaps, M.G.; Furman, D.R.; Green, A.E.S. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32611). J. Appl. Phys. 46: No. 4, 1798-1803 (Apr 1975).

A set of detailed atomic cross sections has been used to obtain the spatial deposition of energy by 1-20-eV electrons in molecular hydrogen by a Monte Carlo simulation of the actual trajectories. The energy deposition curve (energy per distance traversed) is quite peaked in the forward direction about the entry point for electrons with energies above the threshold of the electronic states, but the peak decreases and broadens noticeably as the electron energy decreases below 10 eV (threshold for the $b^3\Sigma^+_u$ state). The curve also assumes a very symmetrical shape for energies below 10 eV, indicating the increasing importance of elastic collisions in determining the shape of the curve, although not the mode of energy deposition. (auth)

31639 BREMSSTRAHLUNG LINEAR POLARIZATION AT INCIDENT ELECTRON ENERGIES OF 0.5-1.5 MeV. Lichtenberg, W.; Przybylski, A.; Scheer, M. (Physikalisches Institut der Universität, D-87 Würzburg, West Germany). Phys. Rev. A 11: No. 2, 480-487 (Feb 1975).

At incident electron energies of 0.5-1.5 MeV, bremsstrahlung linear polarization was measured for thin targets of beryllium, aluminum, silver, and gold at emission angles of 10°-122° as a function of photon energy. Data were corrected for electron scattering in the target and for multiple scattering of photons in the Compton polarimeter used. For low-atomic-number targets the experimental results are perfectly in agreement with Born-approximation theory and with computations using Sommerfeld-Maue eigenfunctions, whereas the high-atomic-number results are described satisfactorily only by partial-wave calculations. (auth)

31640 BUILD-UP REGION OF MEGAVOLTAGE PHOTON RADIATION SOURCES. Velkley, D.E.; Manson, D.J.; Purdy, J.A.; Oliver, G.D. Jr. (Mallinckrodt Institute of Radiology, St. Louis, Missouri 63110). Med. Phys. 2: No. 1, 14-19 (Jan 1975).

Measurements of surface dose and build-up have been measured for photon radiation sources with maximum energy from 1.2 to 25 MeV. A variable volume ionization chamber was used and the results extrapolated to what would be obtained with a zero volume chamber. The results are found to depend systematically on the plate separation of a parallel plate ionization chamber and an empirical method was derived for correcting measurements made with a fixed volume chamber. The relationship of dose build-up curves with skin reactions in radiation therapy patients is discussed. (auth)

31641 TREATMENT PLANNING WITH A GRAPHICS TABLET. Sternick, E.S.; Curran, B.; Hughes, M. (Department of Therapeutic Radiology, Dartmouth-Hitchcock Medical Center, Hanover, New Hampshire 03755). Med. Phys. 2: No. 1, 28-31 (Jan 1975).

A graphics-tablet treatment planning system is described. The cost effectiveness of this approach is especially attractive where time-sharing use of a central computer facility is available. (auth)

31642 HIGH ENERGY ELECTRON RADIOTHERAPY IN A MAGNETIC FIELD. Shih, C.C. (University of Tennessee, Department of Physics and Astronomy, Knoxville, Tennessee 37916). Med. Phys. 2: No. 1, 9-13 (Jan 1975).

We propose the use of high energy electrons in a strong local magnetic field as the ionizing beam in radiation therapy. A high kinetic energy insures that the electrons will penetrate to deep-seated tumor masses. A high magnetic field of several tesla in the region encompassing the tumor will confine the high energy electrons to the tumor volume before the scattering of the beam becomes excessive, thus producing an enhanced electron "Bragg peak" and highly localized strong radiation dose. The conclusions are based on a detailed Monte Carlo model which includes Landau straggling, multiple scattering, and the space dependence of the magnetic field. (auth)

31643 INTERAKCE ENERGETICKYCH ATOMU V PEVNYCH LATKACH. (Interactions of Energetic Atoms with Solids). Jech, C. Prague; Ceskoslovenska Akademie Ved (1974). 124p. (In Czech). 13,-Kcs.

A well arranged review is presented of phenomena occurring in the course of the passage of an energetic atom through solid materials. Attention is paid particularly to interactions in the energy region of 10 eV to 1 MeV. Essential emphasis is put onto processes whose course is affected by regularly arranging the atoms in the crystal lattice, which is the case when considering solids. (auth)

31644 RELATIVISTIC TRANSPORT EQUATION FOR SPIN ½ PARTICLES. de Boer, W. P. H.; van Weert, Ch. G. (Amsterdam Univ. (Netherlands). Instituut voor Theoretische Fysica). Phys. Lett., A; 50: No. 5, 381-382(30 Dec 1974).

For the model of positive energy Dirac particles with short range interaction a transport equation for the one-particle Wigner function is obtained. This transport equation is a generalization of the non-relativistic Walsmann-Snider equation for spin particles. (auth)

31645 SOME GENERAL QUESTIONS OF THE TRANSFER OF FAST ELECTRONS. VII. Multistep Method with Unified Times. Evdokimov, O. B. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 110-114(1974). (In Russian).

The intercept model was generalized in the form of a multistep method with unified times for the calculation of the transport of fast particles. The integral equation was written for a flux with unified times in phase space varying under the condition that the current normally intersects the unified time surface. The Green function for the differential flux operator is the kernel of the integral equation. It was shown that such an integral equation, appearing as a result of a non-steady kinetic equation, gives a uniform algorithm for the solution of the steady-state and non-steady state problems. Examples of the Green function for the operator of the differential flux of fast electrons were given. (tr-auth)

31646 REPETITIVE INTEGRAL MEASUREMENT TECHNIQUE FOR X AND GAMMA RADIATION DOSIMETRY AND DEPTH DOSE SCANNING. Fitzgerald, L. T. Gainesville, FL; Univ. of Florida (1974). 208p. University Microfilms Order No. 75-3490.

Thesis (Ph. D.).

An attempt was made to improve measuring techniques in depth dose scanning of a radiation treatment field with regard to increasing accuracy, speed of measurement and the design of an easily transportable system. A new measurement technique and a new detector transport system have been developed to fulfill these objectives. (MHR)

31647 ENERGY LOSS OF ALPHA PARTICLES IN GASEOUS (OR VAPOR) C-H, C-H-F, AND C-H-O COMPOUNDS. Lodhi, A. S. K. Waco, TX; Baylor Univ. (1974). 151p. University Microfilms Order No. 74-26, 410.

Thesis (Ph. D.).

The stopping powers of ten gaseous (or vapor)compounds $C_2H_2F_2$, $C_2H_4F_2$, $(CH_3)_2O$, $(CH_2)_2O$, C_3H_6O, CH_3OH, C_3H_8, C_4H_8, C_4H_{10}, and C_3H_4 (allene) for alpha particles of energies 0.3 to 2.0 MeV have been measured in a differentially-pumped gas-cell system with probable random errors ranging from 0.7% to 1.3%. An ambiguity in the interpretation of previous stopping power measurements in hydrocarbon and halogencarbon compounds has been resolved, and it is shown that all the previous data as well as the present data involving straight-chain single-bond compounds can be fitted by an atomic stopping power for carbon identical to the vapor-deposited solid carbon stopping power. A rule has been obtained to predict the molecular stopping power of aliphatic saturated hydrocarbons. The stopping power of carbon atoms in hydrocarbons is greater when the atom is bound by a double or triple bond than by a single bond, whereas that of a hydrogen atom is less in a double- or triple-bond hydrocarbons than in a single-bond hydrocarbon. Thus, the atomic stopping power of hydrogen is not always one-half the molecular stopping power of hydrogen, and the atomic stopping power of oxygen in the C-H-O compounds is found to differ from one-half the molecular stopping power of oxygen by as much as 29%. (Diss. Abstr. Int., B)

31648 INTERACTION OF EVANESCENT WAVES WITH MATTER. I. Spontaneous Emission by an Electron Moving Parallel to a Dielectric Boundary. Cherenkov Effect. Vigoureux, J. M.; Payen, R. (Reims Univ., 51 (France)). J. Phys. (Paris); 35: No. 9, 617-630(Sep 1974). (In French).

The spontaneous emission by an electron travelling in a vacuum at constant velocity, parallel and very close to the plane interface with a dielectric was studied by means of a quantum method in terms of evanescent waves. Precise estimates of the intensity and the polarization of the wave emitted in the dielectric for all possible velocities of the electron were obtained. Conclusions were applied to the Cherenkov effect in a homogeneous medium of index n_0. The method yields a deeper understanding of the evanescent wave, and of its role in interactions between matter and radiation. (FR)

31649 MEASURES D'ACTIVITE NUCLEAIRE. (Nuclear Activity Measurements). Paris, France; Masson (1973). 84p. (In French).

Activity measurements can be divided into absolute measurements which give a result expressing the activity of an unknown source in fundamental units and relative measurements in which the activity of the unknown source is compared with that of a reference source without it being necessary to know the actual activity of the two sources. Direct absolute measurements give the required activity directly in fundamental units. Indirect absolute measurements give the required activity in fundamental units through a calibration. The purpose of this work is to define the conditions for carrying out an indirect absolute measurement and more especially a relative measurement, the instruments generally used for this type of measurement being proportional or Geiger-Mueller counters, liquid scintillation counters, scintillation or diode γ spectrometers, γ ionization chambers. Following a brief discussion on interaction phenomena in the case of charged particles, the main parameters liable to affect the quality of the measurement result are reviewed in the different chapters: standards; mode of disintegration of the radionuclide; count rate determination; quality of the instruments (linearity, accuracy); nature of the environment (background); measurement conditions (solid angle) and influence of the source (back-scattering, self-absorption): and measurement threshold, error on the value obtained. (FR)

31650 ABOUT DIFFERENTIAL ALBEDO OF ^{137}Cs GAMMA RAYS. Pozdneev, D. B. (Gorky State Univ., USSR). Ann. Nucl. Sci. Eng.; 1: No. 6, 397(Jun 1974).

Some inexactitudes in the comparison made by Elias et al. [J. Nucl. Energy, 27: 351-62(1973)] between their results, on the differential albedo of ^{137}Cs gamma rays, and those of the author and also of other workers are noted and briefly discussed. The reply by Elias et al. to these comments is also presented. (UK)

31651 MOBILITIES OF K^+ IONS IN He, Ne, H_2, O_2, NO, AND CO_2. James, D. R.; Graham, E.; Akridge, G. R.; McDaniel, E. W. (Georgia Inst. of Tech., Atlanta). J. Chem. Phys.; 62: No. 2, 740-741(15 Jan 1975).

Mobilities of potassium ions were measured in gases over a wide range of ionic energy with a drift tube mass spectrometer at temperatures close to 300°K. By varying the parameter E/N (the ratio of the electrostatic drift field to the gas number density), it was possible to vary the average ionic energy from thermal values up to about 7 eV. (3 figures) (RWR)

Radiation Protection Standards

Refer also to abstract 29862.

31652 PRESENT RADIOPROTECTION REGULATION TRENDS VIEWED BY THE INTERNATIONAL RADIOLOGICAL PROTECTION COMMISSION. Jammet, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). pp 7-17 of Radioprotection Regulations. Montrouge, France; Societe Francaise de Radioprotection ([nd]). (In French)

From meeting on radioprotection regulations; Paris, France (18 Jun 1973).

The latest ideas of the International Radiological Protection Commission (IRPC) and their possible repercussions in the field of legislation are reported. Where the problem of the dose effect relationship is concerned, the commission retains the cautions assumptions of an absence of threshold and a linear dose-effect relationship. Since the purpose of the IRPC recommendations has always been to fix limits, i.e., maximum values offering satisfactory working conditions, the validity of this dose limit system has been reexamined in the light of present knowledge. It is found that the factors on which these limits were based still hold good and the IRPC has therefore confirmed the validity of this system. Concerning the practical application of the commission's recommendations it is important to distinguish between the fundamental irradiation limits which govern health restrictions and all the derived or practical limits to which they can lead. The commission wishes to leave a large degree of initiative to users in the application of its recommendations. With regard to the irradiation of populations, the former policy was merely to issue general recommendations; however since these have given rise to improper interpretations, especially in the case of paragraph 52 of the document IRPC 9, the commission has decided to publish a report explaining its intensions and dealing also with the cost-profit analysis. Special emphasis is placed on the interpretation of these texts as regards their practical application. (FR)

31653 RADIATION PROTECTION WHEN HANDLING WITH UNSEALED RADIOACTIVE MATERIAL IN MEDICAL PLANTS. Rules. pp DIN-6843 of German Norms. Berlin, F. R. Germany; Beuth (Dec 1973). (In German)

2 figs.; 4 tabs.

This standard specifies the rules set up for medical plants where unsealed radioactive material is used. (GE)

Radiation Source Calibration and Standardization

Refer also to abstract 31649.

31654 COINCIDENCE METHODS OF STANDARDIZATION FOR ^{131}Cs AND MEASUREMENT OF DECAY PARAMETERS. Pich, J.; Zderadicka, J.; Kokta, L. (Inst. for Research, Production, and Application of Radioisotopes, Prague). Int. J. Appl. Radiat. Isotop.; 25: No. 10, 433-444(Oct 1974).

Coincidence methods for standardizing ^{131}Cs based on the detection of L Auger electrons plus L x-rays in 2π (4π) proportional counters and the detection of K x-rays by means of NaI(Tl) or Si(Li) detectors are theoretically discussed and experimentally tested. Both integral and differential regimes in the L channel are considered. It is shown that a solution with very low carrier concentration can be standardized with an accuracy of about 1%. Combining measurements of K Auger electrons and K x-rays a new value of $\omega_K(Xe) = 0.883 \pm 0.004$ has been determined. On the basis of the K x-ray and activity measurements the value $P_K\omega_K = 0.734 \pm 0.006$, $P_K = 0.832 \pm 0.008$ and the half-life 9.688 ± 0.004 days have been found. A standardization method based on the emission-rate measurement of K x-rays is proposed; the activity of a source can be determined with an accuracy of about 1%. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 31633, 31852, 31979, 32160, and 32232.

31655 (RN-TM-0588) USERS MANUAL: FMC-G, FLEXIBLE MONTE CARLO-GAMMA. Koebberling, K. O.; Reuss, W. J. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1969. 17p. Dep. NTIS $4.00.

Monte Carlo methods are used to simulate gamma ray life history in a source-shield configuration. The program is designed for flexibility in the geometrical, material, nuclear and source descriptions of source-shield configurations and variance reduction techniques. Some changes made to the original program include the FASTER geometry input format and coupling of runs together. (MHR)

31656 (TID/SNA-357) DEVELOPMENT OF AN INTEGRATED SYSTEM OF NEUTRON-INDUCED-ACTIVATION AND SHIELDING COMPUTER CODES FOR COMPLEX ENGINEERING STRUCTURES. Folder 1. Technical. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 23 Oct 1969. 50p. Dep. NTIS $5.50.

The analysis of neutron-induced-activation gamma radiation levels is separated into three parts: neutron transport, neutron activation, and gamma transport. Each is discussed with brief reference to specific codes and groups of codes. A program is proposed to develop an integrated system of computer codes to compute photon dose rates generated in complicated engineering structures as a result of neutron-induced activation. Information is included on experience in NERVA radiation and shielding analysis and integrated computer-code systems, and management organization and personnel. (MHR)

31657 (WANL-TME-1273) SAP: A NEUTRON AND GAMMA RAY ALBEDO MODEL SCATTER SHIELD ANALYSIS PROGRAM. Stephenson, L. D.; Planinsek, F.; Killinger, A.; Sapovchak, B. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1965. 35p. Dep. NTIS $4.75.

This report describes the formulation and operation of the SAP program. The SAP program employs albedo techniques to compute neutron or gamma ray scattering from a plane surface. (3 figures) (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 30847, 31136, and 31696.

31658 (CNRS-CPT-74/P.619) TOTALLY MONOTONIC AND TOTALLY POSITIVE SEQUENCES FOR THE PADÉ APPROXIMANTS METHOD. Gilewicz, J. (Centre National de la Recherche Scientifique, 13 – Marseille (France). Centre de Physique Theorique). [nd]. 13p. Dep. NTIS (U. S. Sales Only) $4.00.

The convergence of Padé approximants (PA) to an analytic function is very well known if the sequence of the coefficients of the power series of this function is totally (completely) monotonic or totally positive. The new and old criteria are given to check the properties TM and TP of sequences. (auth)

31659 (ITP-74-129E) UNITARITY OF SOME CANONICAL TRANSFORMATIONS OF ANTICOMMUTATION RELATIONS. Burban, I. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

Necessary and sufficient conditions of unitarity of the Dirac transformations are found in the class of all irreducible direct and primary direct product representations of canonical anticommutation relations. For charged fermi-fields there are found necessary and sufficient conditions of unitarity of the Bogoliubov transformations in the class of irreducible direct product representations of anticommutation relations. (auth)

31660 (ORNL-TM-4848) SMOOTH TRANSITION OF NEOCLASSICAL DIFFUSION FROM THE BANANA TO PFIRSCH–SCHLUETER REGIME. Tsang, K. T.; Callen, J. D. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 12p. Dep. NTIS $4.00.

It is shown that neoclassical transport coefficients obtained previously by numerical evaluation of variational procedures can be reproduced analytically by taking account of the energy dependence of the collision and bounce frequencies through the separation of velocity space into banana, plateau and Pfirsch-Schlüter regimes. (auth)

31661 PHASE SHIFTS OF THE STATIC SCREENED COULOMB POTENTIAL. Grandjouan, N.; Deutsch, C. (Laboratoire de Physique des Plasmas, Université Paris XI, Centre d'Orsay, 91405–Orsay, France). Phys. Rev. A 11: No. 2, 522-527 (Feb 1975).

Phase shifts and their weighted sum over angular momentum are reconsidered for the static screened Coulomb potential (SSCP). Results are given for both an attractive and a repulsive SSCP. The numerical results are derived in the present work from two independent and simple techniques based upon the Numerov method and the variable–phase approach, respectively, applied to the Sturm–Liouville form of the Schrödinger equation. Special emphasis is given to the high–density low–temperature domain ($\lambda_D < 10$ a.u.). Excellent agreement is found with results obtained previously by Rogers using the WKB approximation. (auth)

31662 METOD ISSLEDOVANIYA MODEL'NYKH GAMIL'TONIANOV. (Methods of Investigating Model Hamiltonians). Bogolyubov, N. N. Jr. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1974). 176p.

Methods are proposed for the solution of some problems of statistical physics containing four-fermion interaction. By means of the method of approximate Hamiltonians an integral class of precisely soluble model systems could be resolved. The substantial difference of two types of problems with positive and negative four-fermion interactions is shown and examined. For each of these types of problems the occurrence of precise solutions for the free energy, many-time correlation functions, T products, and Green functions is examined. The very general problem whose Hamiltonian contains both terms with positive and terms with negative four-fermion interactions are also studied. On the basis of the analysis and generalization of the results the possible formulation and development is begun on a new principle, that of a minimax for problems of statistical physics. (tr-auth)

31663 THE SCHRÖDINGER EQUATION IN HELICAL COORDINATES. Garavaglia, T. (Coláiste Teichneólaiochta, Sráid Chaoimhin, agus, Institiúid Árd–Léighinn, Baile Átha Cliath, Éire); Gomatam, J. Ann. Phys. (N.Y.) 89: No. 1, 1-10 (Jan 1975).

Orthogonal coordinate systems with helical geometry are constructed in euclidean 3–space and the Schrödinger equations in these coordinate systems are obtained. Of the two helical coordinate systems discussed, the external system consists of flat surfaces while the internal system consists of surfaces of constant Gaussian curvature. A singular cylinder separates these two systems. (auth)

31664 CONSISTENCY IN THE FORMULATION OF THE DIRAC, PAULI, AND SCHROEDINGER THEORIES. Gurtler, R.; Hestenes, D. (Arizona State Univ., Tempe). J. Math. Phys. (N. Y.); 16: No. 3, 573-584(Mar 1975).

Properties of observables in the Pauli and Schroedinger theories and first order relativistic approximations to them are derived from the Dirac theory. They are found to be inconsistent with customary interpretations in many respects. For example, failure to identify the "Darwin term" as the s-state spin-orbit energy in conventional treatments of the hydrogen atom is traced to a failure to distinguish between charge and momentum flow in the theory. Consistency with the Dirac theory is shown to imply that the Schroedinger equation describes not a spinless particle as universally assumed, but a particle in a spin eigenstate. The bearing of spin on the interpretation of the Schroedinger theory is discussed. Conservation laws of the Dirac theory are formulated in terms of relative variables, and used to derive virial theorems and the corresponding conservation laws in the Pauli-Schroedinger theory. (auth)

31665 OBSERVABLES, OPERATORS, AND COMPLEX NUMBERS IN THE DIRAC THEORY. Hestenes, D. (Arizona State Univ., Tempe). J. Math. Phys. (N. Y.); 16: No. 3, 556-572(Mar 1975).

The geometrical formulation of the Dirac theory with space-time algebra is shown to be equivalent to the usual matrix formalism. Imaginary numbers in the Dirac theory are shown to be related to the spin tensor. The relation of observables to operators and the wave-function is analyzed in detail and compared with some purportedly general principles of quantum mechanics. An exact formulation of Larmor and Thomas precessions in the Dirac theory is given for the first time. Finally, some basic relations among local observables in the nonrelativistic limit are determined. (auth)

31666 SOME REMARKS ON THE EVOLUTION OF A SCHROEDINGER PARTICLE IN AN ATTRACTIVE $1/r^2$ POTENTIAL. Radin, C. (Univ. of Pennsylvania, Philadelphia). J. Math. Phys. (N. Y.); 16: No. 3, 544-547(Mar 1975).

Comparing the different solutions of Case and Nelson for the evolution operators of a Schroedinger particle in the potential $V(r) = -1/r^2$, it is shown that Nelson's nonunitary solution is a simple average, over a physical parameter related to a boundary condition at the singularity, of Case's family of solutions. (auth)

31667 LIE THEORY AND SEPARATION OF VARIABLES. VII. The Harmonic Oscillator in Elliptic Coordinates and Ince Polynomials. Boyer, C. P. (Univ. Nacional Autonoma de Mexico, Mexico City); Kalnins, E. G.; Miller, W. Jr. J. Math. Phys. (N. Y.); 16: No. 3, 512-517(Mar 1975).

As a continuation of previous work, a study is made of the separable basis eigenfunctions and their relations for the harmonic oscillator Hamiltonian in two space variables with special emphasis on products of Ince polynomials, the eigenfunctions obtained when one separates variables in elliptic coordinates. The overlaps connecting this basis to the polar and Cartesian coordinate bases are obtained by computing in a simpler Bargmann Hilbert space model of the problem. It is also shown that Ince polynomials are intimately connected with the representation theory of SU(2), the group responsible for the eigenvalue degeneracy of the oscillator Hamiltonian. (auth)

31668 PERTURBATIVE-VARIATIONAL APPROXIMATIONS TO THE SPECTRAL PROPERTIES OF SEMIBOUNDED HILBERT SPACE OPERATORS, BASED ON THE MOMENT PROBLEM WITH FINITE OR DIVERGING MOMENTS. Application to Quantum Mechanical Systems. Bessis, D.; Villani, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Math. Phys. (N. Y.); 16: No. 3, 462-474(Mar 1975).

In a systematic way the properly defined arctangent of the mean value of the resolvent of a Hilbert space operator is introduced. The case of semibounded self-adjoint operators H in the region of the discrete spectrum is considered more precisely. The arctangent of the Padé approximations to the mean value of the resolvent are constructed out of the moments. They are shown to provide converging monotonic increasing sequences of lower bounds to the arctangent of the resolvent. Consequently bounds

with the same properties are derived for the discrete eigenvalues of H and, most remarkable, the ordering of the corresponding poles of the approximations reproduces the ordering of the exact poles. The Padé method is shown to provide a way to fully exploit the content of the Rayleigh-Ritz variational method, by providing a simple mechanical procedure to build up the variational subspaces: It defines a powerful both perturbative and variational approximation to semibounded operators. The difficulties of the Ritz method in the degenerate case are overcome by the fact that all bounds in the Padé method are strict bounds. One considers the important case in which the moments are given by diverging algorithms. By properly regularizing them, it is shown that the Padé-Ritz variational principle generalizes to produce absolute maxima of the arctangent of the Padé approximations in the regulator and that these maxima form monotonic converging sequences of lower bounds. One discusses an application to quantum mechanical systems for which the perturbative variational method is applied to the energy, allowing one to treat the case of strong coupling. As a consequence it appears possible to solve (approximately) the R-dimensional anharmonic oscillator in a purely algebraic way. (auth)

31669 USEFUL EXTREMUM PRINCIPLE FOR THE VARIATIONAL CALCULATION OF MATRIX ELEMENTS. II. Gerjuoy, E. (Univ. of Pittsburgh); Rosenberg, L.; Spruch, L. J. Math. Phys. (N. Y.); 16: No. 3, 455-461(Mar 1975).

Recent work (Phys. Rev. A 9, 108 (1974)) on variational principles for diagonal bound state matrix elements of arbitrary Hermitian operators is extended. In particular, it is shown that the previously derived minimum principle for the trial auxiliary function appearing in such variational principles can be constructed using a modified Hamiltonian possessing not heretofore recognized positive definite properties. Thus there is at least one alternative to the particular modified Hamiltonian on which the results of Phys. Rev. A 9, 108 (1974) originally were based. (auth)

31670 TENSOR OPERATORS AND TWISTED GROUP ALGEBRAS. Backhouse, N. B. (Univ. of Liverpool). J. Math. Phys. (N. Y.); 16: No. 3, 443-447(Mar 1975).

Two generalizations of Frame's theory of the conjugating representation of a finite group G are explored and applied to the problem of forming tensor operators out of a group algebra. In each case the group G acts on the group algebra $A(\bar{G})$, where $\bar{G}$ either contains G or covers G as a central extension. By construction, an affirmative answer is given to the question, raised by de Vries and van Zanten, as to whether or not $\bar{G}$ may be found such that $A(\bar{G})$ carries all the irreducible representations of G. Several examples are given, with the groups chosen from among the crystallographic point groups. (auth)

31671 A CLASS OF TRANSFORMATIONS ON THE DIRAC HAMILTONIAN Tekumalla, A. R. (Matscience, Madras (India)) Physica; 78: No. 1, 191-197(1974).

A new generalization of the Foldy-Wouthuysen transformation is given and a simple and elegant method of obtaining explicit forms of the Foldy-Wouthuysen transformation and its generalizations using the U-matrix method of Ramakrishnan is shown. It is also shown how this method can be used to obtain the transformation which connects the Dirac equation to the noncovariant form of the Dirac equation recently discussed in the literature. (auth)

31672 COULOMB WAVE FUNCTIONS FOR ALL REAL ETA AND RHO. Barnett, A. R.; Feng, D. H.; Steed, J. W.; Goldfarb, L. J. B. (Manchester Univ. (UK). Dept. of Physics). Comput. Phys. Commun.; 8: No. 5, 377-395(Dec 1974).

An entirely new technique, developed by Steed, is used, which differs greatly from standard methods. The method is based on the continued-fraction expansion of the quantities $F_1'F_1$ and $(G_1' + F_1')/(G_1 + iF_1)$ and it is applicable for all values of $\rho \geq \rho_{TP} = \eta + [\eta^2 + 1(1 + 1)]^{\frac{1}{2}}$ without restriction. A somewhat modified method is used for values of $\rho < \rho_{TP}$. The results are given for all l-values between MINL and MAXL inclusive (MAXL ≥ MINL ≥ 0) and for any required ρ-value. In general results are obtained without integrating the differential equation. The subroutine is fast and compact; the results can be obtained to any desired accuracy in the range $10^{-6}-10^{-12}$. (auth)

31673 INTERPRETATION OF QUANTUM MECHANICS. Bub, J. University of Western Ontario series in Philosophy of Science, Volume 3. Boston; D. Reidel Publishing Company, Inc. (1974). 163p. $50.00.

The topics discussed are the statistical algorithm of quantum mechanics, problem of completeness, Von Neumann completeness proof, lattice theory: the Jauch and Piron proof, the imbedding theorem of Kochen and Specker, the Bell–Wigner locality argument, resolution of the completeness problem, the logic of events, imbeddability and validity, the statistics of non-Boolean event structures, the measurement problem, and the interpretation of quantum mechanics. (JFP)

31674 ANGULAR CORRELATION OF SCATTERED ANNIHILATION PHOTONS, TO TEST THE POSSIBILITY OF HIDDEN VARIABLES IN QUANTUM THEORY. Faraci, G.; Gutkowski, D.; Notarrigo, S.; Pennisi, A. R. (Catania Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Catania (Italy). Sezione di Catania). Appl. Phys.; 5: No. 1, 63-65(Oct 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

Angular correlations of the annihilation photons, Compton scattered by plastic scintillators and detected by means of NaI(Tl) crystals, were measured in order to test the possibility of deviations of the experimental results from the predictions of the quantum theory. In fact, Jauch and Bohm, starting with different motivations, both arrive at the possibility of a lower correlation ratio between the two orthogonal polarization states of the two photons than predicted by quantum theory. The experimental results compared with the theoretical predictions, after correction for finite geometry by means of a Monte Carlo method, do not confirm quantum theory and exclude the hypotheses of Jauch and of Bohm. (auth)

31675 CLASSICAL THEORY OF CHARGED AND SPINNING TACHYONS. Fleury, N.; Leite Lopes, J.; Oberlechner, G. (Centre de Recherches Nucleaires, Strasbourg). Acta Phys. Austr.; 38: No. 2, 113-122(1973).

The classical equations of motion of a charged tachyon in an electromagnetic field are postulated. They show that a tachyon which travels backward in time with negative energy behaves as an oppositely charged tachyon travelling forward in time with positive energy. The retarded and advanced fields are divergent at the tachyon world-line and on a surface corresponding to the Cherenkov cone; but the Dirac radiation field is finite at the tachyon world-line and gives rise to a finite energy loss similar to the one computed in the classical electron theory. Finally the Bargmann–Michel–Telegdi equation for classically spinning particles is transcribed in the case of tachyons. (auth)

Quantum Field Theories

Refer also to abstracts 30916, 31001, 31111, and 31734–31736.

31676 (CNRS-CPT-74.P-613(Rev.)) QUANTIZED FIELDS IN INTERACTION WITH EXTERNAL FIELDS. Bellissard, J. (Centre National de la Recherche Scientifique, 13 – Marseille (France). Centre de Physique Theorique). Apr 1974. 65p. Dep. NTIS (U. S. Sales Only) $6.25.

A massive, charged, scalar quantized field interacting with an external classical field is considered. Guided by renormalized perturbation theory it is shown that whenever the integral equations defining the Feynman or retarded or advanced interaction kernel possess non-perturbative solutions, there exists an S operator which satisfies, up to a phase, the axioms of Bogoliubov, and is given for small external fields by a power series which converges on coherent states. Furthermore this construction is shown to be equivalent to the one based on the Yang-Feldman equation. This is a consequence of the relations between chronological and retarded Green's functions which are described in detail. (auth)

31677 (CNRS-CPT-74/P-618) IRREDUCIBLE LORENTZ COVARIANT FREE FIELDS. Bellissard, J. (Centre National de la Recherche Scientifique, 13 – Marseille (France). Centre de Physique Theorique). May 1974. 22p. Dep. NTIS (U. S. Sales Only) $4.25.

Free fields describing assemblies of irreducible systems of mass $m > 0$ and spin s, and transforming as: $U(a_1A)\psi_\alpha(x)U(a_1A)^{-1} = S_{\beta\alpha}(A^{-1})\psi_\beta(An + a)$ are classified under the Poincaré group, where $S(A)$ is a given finite dimensional representation of $SL(2\alpha)$. (auth)

31678 (CNRS-CPT-74/P.623) QUANTIZED FIELDS IN EXTERNAL FIELD. II. Existence Theorems. Bellissard, J. (Centre National de la Recherche Scientifique, 13 – Marseille (France). Centre de Physique Theorique). Jun 1974. 39p. Dep. NTIS (U. S. Sales Only) $5.00.

A study is made of quantized fields interacting with a smooth classical external field with fast space-time decrease. The case of a charged scalar field is considered first. The existence of the corresponding Green's functions is proved. For weak fields,

as well as pure electric or scalar external fields, the Bogolioubov S-operator defined is shown to be unitary, covariant, causal up-to-a-phase. Its perturbation expansion is shown to converge on a dense set in Fock space. These results are generalized to a class of higher spin quantized fields, "nicely" coupled to external fields, which includes the Dirac theory, and, in the case of minimal and magnetic dipole coupling, the Petiau–Duffin–Kemmer theory. (auth)

31679 (CNRS-CPT-74.P.625) ABELIAN HIGGS–KIBBLE MODEL. Unitarity of the S-Operator. Becchi, C.; Rouet, A.; Stora, R. (Centre National de la Recherche Scientifique, 13 – Marseille (France). Centre de Physique Theorique). Jun 1974. 7p. Dep. NTIS (U. S. Sales Only) $4.00.

Results concerning the renormalization of the abelian Higgs Kibble model in the 't Hooft gauges are presented. A direct combinatorial proof of the unitarity of the physical S-operator is described. (auth)

31680 (ITF-74-15IP) RENORMALIZED FEYNMAN AMPLITUDES FOR FIXED MASS FIELDS. Shcherbina, V. A.; Chudinovich, I. Yu. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

One of the methods of propagator flattening in the field theory is the addition of an imaginary quantity to the mass value squares of the corresponding fields. The existence of the limit of renormalized Feynman amplitudes while passing to the real meanings of the mass fields is studied. The existence of this limit both for nonzero mass theories and the large set of renormalized amplitudes in the theories with zero masses is proved. (auth)

31681 (ITP-74-130E) WIGHTMAN AXIOMS FOR CONCENTRATABLE FIELD AND RECONSTRUCTION THEOREM. II. Local Properties of the Field. Lomsadze, Yu. M.; Krivskii, I. Yu.; Shuba, I. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 44p. Dep. NTIS (US Sales Only) $5.25.

The construction of the axiomatic scheme commenced previously is continued. Two, generally speaking, different formations are given for the axiom of concentration of the Wightman field $\varphi(f)$ in the real space-time R^4_x – the WR–and the OR-axioms. For the OR-field the notion of the field $\hat{\varphi}_\Delta(f)$ in any set $\Delta \subseteq R^4_x$ is introduced and in its terms the axiom of local commutativity is formulated. The inner consistency of all the axioms adopted in the given scheme is demonstrated by way of example of the free field. (auth)

31682 SINE-GORDON EQUATION AS A MODEL CLASSICAL FIELD THEORY. Caudrey, P. J. (UMIST, Manchester, Eng.); Eilbeck, J. C.; Gibbon, J. D. Nuovo Cim.; 25B: No. 2, 497-512 (11 Feb 1975).

The sine-Gordon equation $\varphi_{xx} - \varphi_{tt} = m^2 \sin \varphi$ is considered as a model one-dimensional classical field theory with particle-like solutions. The model has applications in many branches of physics and gives an exact description of the interaction of an arbitrary number of elementary particles and bound-state composite particles. (auth)

31683 REMARKS ON COMPOSITE AND UNSTABLE OBJECTS IN QUANTUM FIELD THEORY. Krolikowski, W. (Univ. of Warsaw); Rzewuski, J. Nuovo Cim.; 25B: No. 2, 739-756(11 Feb 1975).

The possibility to describe composite and unstable objects in the frame of quantum field theory is discussed. The basis for the discussion is provided by the equation for the "distinguished component" of the state vector, i.e. the component in a closed subspace of the given Hilbert space. The case when the subspace is an n-particle subspace is discussed in more detail. In particular the interaction between bound states is derived from the interaction of their constituents. (auth)

31684 TWO-DIMENSIONAL EXACTLY SOLVABLE MODELS. Some Remarks. Dell'Antonio, G. F. (New York Univ.). Nuovo Cim.; 25A: No. 2, 303-330(21 Jan 1975).

One studies in some detail the Thirring model with internal degrees of freedom and the Schwinger model. By using this analysis it is shown how to construct exact solutions for a large class of two-dimensional models describing the interaction of massless vector and spinor fields. (auth)

31685 RENORMALIZATION GROUP IN THE FRAMEWORK OF ANALYTIC REGULARIZATION. Marinaro, M. (Univ., Salerno, Italy). Nuovo Cim.; 25A: No. 2, 284-288(21 Jan 1975).

A derivation of renormalization group equations in the framework of analytic regularization is presented for scalar field theory with $g\varphi^4$-interaction. (auth)

31686 FEYNMAN GRAPHS FOR SUPERFIELDS. Capper, D. M. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim.; 25A: No. 2, 259-272(21 Jan 1975).

A technique is presented for constructing Feynman graphs directly from superfields rather than from the constituent fields. Using as an example the theory of a scalar multiplet, it is shown how such a technique simplifies a discussion of the divergences for multiloop diagrams. (auth)

31687 RATIO OF VERTEX FUNCTIONS AT LARGE MOMENTA. Grosser, D. (Univ. of Tuebingen, Ger.). Nuovo Cim.; 25A: No. 2, 193-198(21 Jan 1975).

In a Lagrangian field theory with strong and electromagnetic interaction, the large-momenta behavior of the ratio of vertex functions with the same number of external hadron vertices is studied. The vertex functions are approximated to lowest order with respect to electromagnetic interaction. Using the new renormalization group equation it is shown that this ratio exhibits canonical scaling behavior at large momenta provided the effective mass and the effective coupling constant remain finite at such momenta. The result is not restricted to nonexceptional momenta. (auth)

31688 CONFORMAL INVARIANCE OF QUANTUM FIELDS IN TWO–DIMENSIONAL SPACE–TIME. Kupsch, J.; Rühl, W.; Yunn, B.C. (Universität Trier–Kaiserslautern, Fachbereich Physik, Kaiserslautern). Ann. Phys. (N.Y.) 89: No. 1, 115-148 (Jan 1975).

Our investigations of conformal invariance are based on the theory of analytic representations of the conformal group and its universal covering group. With its help the action of the conformal group on free massless fields, Greenberg fields, Wick products of these fields, and the Thirring fields is studied. In this context we find an infinite set of new operator solutions for the Thirring model that are all equivalent to each other. Explicit constructions of the nonlocal special conformal transformations of all these fields are given. (auth)

31689 WEYL AND DIRAC EQUATIONS IN TERMS OF FUNCTIONS OVER THE GROUP SU_2. Malin, S. (Colgate Univ., Hamilton, NY). J. Math. Phys. (N. Y.); 16: No. 3, 679-684(Mar 1975).

Carmeli's approach to Maxwell's equations, in which the field variables are considered as functions of the group SU_2 is extended to two-component Weyl spinors and four-component Dirac spinors. The Weyl and Dirac equations are formulated over the group SU_2, the relevant functions are shown to be "quantities of spin-weight $s = \pm\frac{1}{2}$"; they are expanded in a generalized Fourier series and the equations for the coefficients are derived. The "quantities of spin-weight s" are shown to be closely related to eigenvectors and eigenspinors of the radial spin operator $\hat{n} \cdot s$. (auth)

31690 SPINOR FIELD THEORY ON A SEVEN-DIMENSIONAL HOMOGENEOUS SPACE OF THE POINCARE GROUP. Ardalan, F. (Arya-Mehr Univ. of Tech., Tehran); Fleming, G. N. J. Math. Phys. (N. Y.); 16: No. 3, 478-484(Mar 1975).

A field theory of half-integer spin particles is constructed on a seven-dimensional homogeneous space of the Poincaré group. The mass spectrum consists of nonparallel linear trajectories. The field theory has no spacelike or lightlike solutions. Electromagnetic form factors and structure functions of the theory are discussed. (auth)

31691 GENERALIZED SUPERGAUGE TRANSFORMATION AND SUPERFIELDS. Srivastava, P. P. (International Centre for Theoretical Physics, Trieste, Ger.). Lett. Nuovo Cim.; 12: No. 6, 161-164(8 Feb 1975).

Scalar superfields invariant under a given transformation, which it is shown also constitute a group which includes the definition of a supergauge transformation as a special case, are treated. (JFP)

31692 BOUND STATE QUANTUM ELECTRODYNAMICS WITH POLARIZATION SOURCES. Babiker, M. (Khartoum Univ., Sudan). Proc. Roy. Soc. (London), Ser. A; 343: No. 1628, 113-129 (25 Feb 1975).

A manifestly gauge invariant relativistic quantum field theory of the interaction of atomic systems with electromagnetic fields is shown to be systematically obtained from conventional quantum electrodynamics. The basic ingredient is an exact decomposition of the Dirac sources J^μ, modified to include the binding, into polarization sources p and M. The transformation of the conventional theory is achieved by means of a generalized Power-Zienau-Woolley transformation (Power and Zienau Phil. Trans. R. Soc. Lond.; A251: 427 (1959) and Woolley Proc. R. Soc. Lond.; A321: 557 (1971)). While J^μ couple to the potentials A^μ, the polarization sources are shown to couple directly to the field intensities E and B. An explicit separation between electric and magnetic interac-

tions is thus obtained which is in close correspondence with the case in the semi-classical radiation theory. The relevance of the transformed theory to problems involving intense electromagnetic fields is pointed out and discussed. (auth)

31693 MOMENTUM AND ANGULAR MOMENTUM IN PREDICTIVE RELATIVISTIC ELECTRODYNAMICS. Diez Gil, J. L.; Salas, A. (Univ. Autonoma de Madrid). J. Phys., A (London); 8: No. 2, 195-202(Feb 1975).

The formulas for the total momentum and angular momentum of a system of two point-charges in Wheeler-Feynman electrodynamics are integrated using the approximate parametric equations of the trajectories in predictive relativistic mechanics. The zero- and first-order terms in the expansion in power series of $g \equiv e_1e_2$ are evaluated exactly, and the second-order term is calculated approximately for slow motion. (auth)

31694 HAMILTON THEORY OF THE INTERACTION OF MASSIVE VECTOR AND MASSLESS FERMION FIELDS IN TWO-DIMENSIONAL SPACE-TIME: $(\bar{\psi}\gamma_\mu\psi\beta_\mu)_2$-INTERACTION. I. Space of States with the Positive-Definite Metrics. Pogrebkov, A. K.; Sushko, V. N. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 22: No. 2, 159-176(Feb 1975). (In Russian).

Wightman fields for the interaction of massless fermions with massive vector bosons in two-dimensional space-time are constructed in the framework of the Hamilton formalism. (auth)

31695 CONSTRUCTION OF NON-LOCAL QUANTUM ELECTRODYNAMICS OF BOSONS WITH SPINS 0 AND 1. Efimov, G. V.; Namsrai, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 22: No. 2, 186-202(Feb 1975). (In Russian).

Nonlocal quantum electrodynamics of particles with the spins 0 and 1 is constructed in the Duffin-Kemmer formalism. The perturbation theory of interactions of mesons with the electromagnetic fields is considered. The S-matrix is finite, unitary, causal and gauge-invariant. (auth)

31696 LAGRANGIAN QUANTUM THEORY. IV. Schouten Concomitants and the Dirac Problem. Bloore, F. J. (Dalhousie Univ., Halifax, Nova Scotia, Canada). J. Phys., A (London); 8: No. 2, 179-185(Feb 1975).

Hamilton's principle of stationary action in classical mechanics is formulated using the Lie algebra of Schouten concomitants of symmetric contravariant tensor fields on the configuration space of the system. Such a formulation is global and coordinate free. It is shown that a directly parallel formulation holds in quantum mechanics so long as all the Poisson brackets involved can be replaced in the quantum version by commutators in a canonical way. An example is discussed (where the Hamiltonian possesses a velocity-dependent potential) in which this cannot be done, and it is concluded that in this case the action is stationary only for a subclass of variations, namely those corresponding to Killing vector fields on the configuration manifold. (auth)

31697 VORTICES AND QUARK CONFINEMENT IN NON-ABELIAN GAUGE THEORIES. Mandelstam, S. (California Univ., Berkeley (USA). Dept. of Physics). Phys. Lett., B; 53: No. 5, 476-478(6 Jan 1975).

It is shown that finite-length vortices in an SU(n) Nielsen-Olesen model require explicit introduction of monopoles which are confined in multiples of n by the Meissner effect. The model therefore possesses a natural explanation of quark confinement. (auth)

31698 GENESIS OF FIELD THEORETICAL BAGS AND e^+e^- ANNIHILATION. Vinciarelli, P. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 53: No. 5, 457-461(6 Jan 1975).

A new approach to the long standing problem of binding quarks to make hadrons within the context of a local relativistic field theory was suggested by the present author more than two years ago. The suggestion was based on the observation that in theories where spontaneous symmetry breaking occurs and certain (scalar) fields acquire a non-vanishing vacuum expectation value, configurations in which the expectation value of such fields actually vanishes in a finite region of space may be energetically favoured and correspond to physical bound states of the theory. Thus, the formation of bound states would be tied to the "local restoration" of symmetries which globally are spontaneously broken. Some of the immediate implications of this field theoretical bag model on reactions involving leptons and hadronic bags are discussed. (auth)

31699 GAUGE FIELD THEORIES. Veltman, M. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 429-447 of Proceedings of the Sixth International Symposium on Electron and Photon Interactions at High Energies Held at Bonn, F. R. Germany, 27-31 Aug 1973. Rollnik, H.; Pfeil, W. (eds.). Amsterdam; North-Holland Publishing Company (1974).

From 6th international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). 74 refs.

Recently, an interesting argument in favor of a gauge theory of strong interactions has attracted attention. A simple account of this development is given and the important question of higher order effects is discussed. The renormalization program and associated problems are outlined. The definition of physical particles following the method essentially due to Kibble (1967) is discussed and the question of the validity of PCAC and low-energy theorems is considered. (auth)

31700 FORMULATION OF THEORIES WITH ZERO-MASS PROPAGATORS. Lowenstein, J. H.; Zimmermann, W. (New York Univ., N. Y. (USA). Dept. of Physics). Nucl. Phys., B; 86: No. 1, 77-103(3 Feb 1975).

A new renormalization scheme is proposed for theories with zero-mass propagators. For each Feynman diagram the method yields an ultraviolet and infrared convergent contribution to the Green functions. The method is first developed for the massless A^4 model and then applied to the Goldstone and pre-Higgs models. (auth)

31701 FEYNMAN RULES FOR SUPERFIELDS. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 86: No. 1, 142-152(3 Feb 1975).

The notion of functional differentiation with respect to superfields is defined and used to set up formal rules for computing Green functions and scattering amplitudes in supersymmetric models. (auth)

31702 A NOTE ON DIMENSIONAL REGULARIZATION METHOD IN THE PRESENCE OF INFRARED DIVERGENCES. Meuldermans, R. (Instituut voor Theoretische Natuurkunde, Leuven, Belgium). Nucl. Phys., B; 86: No. 2, 355-359(10 Feb 1975).

A practical way of applying the dimensional regularization scheme in the presence of infrared divergences, consisting of a finite subtraction procedure is indicated. (auth)

31703 ELASTIC ELECTRON SCATTERING IN AN INTENSE FIELD AND TWO-PHOTON EMISSION. Morozov, D. A.; Ritus, V. I. (AN SSSR, Moscow. Fizicheskij Inst.). Nucl. Phys., B; 86: No. 2, 309-332(10 Feb 1975).

The elastic scattering amplitude, taking into account the mass correction to the propagation function, is found for electrons interacting with an intense electromagnetic field characteristic of non-linear quantum electrodynamics. The probability for two-photon emission $e \rightarrow e2\gamma$, the mass correction to the probability for one-photon emission and the mass correction to the anomalous field-dependent magnetic moment of the electron are found with the aid of the amplitude. (auth)

31704 YANG-MILLS FIELDS IN GRAVITATIONAL THEORY. I. Yang-Mills Theory and Geometry. Holonome Theory. Burghardt, R. (Univ., Graz). Acta Phys. Austr.; 38: No. 4, 327-335 (1973). (In German).

By application of a four-dimensional formalism Riemann geometry was explained as a deformation theory. By definition of an invariant transition a tensor magnitude appears which has the character of a Yang-Mills field and can be reduced to a covariant formulation of the gravitational theory. (tr-auth)

31705 CAUCHY PROBLEM FOR THE YANG-MILLS FIELD EQUATIONS. Kerner, R. (Paris-6 Univ., 75 (France)). Ann. Inst. Henri Poincare, Sect. A; 20: No. 3, 279-283(1974).

It is proved that for any given solution A^0 of the Lang-Mills field equations, which belongs to the functional space $H^{m+1}V_T^\omega$, $m > 2$, where V^ω_T is an open subset of space-time of arbitrary (but finite) temporal width, there exists an infinite number of exact solutions A such that their Cauchy data are near in the sense of $H^{m\omega}$ to the Cauchy data of A^0 and they are near themselves to A^0 in the sense of $H^{m+1}V^\omega_T$. (FR)

31706 A CONCEPT OF EXPLAINING THE PROPERTIES OF ELEMENTARY PARTICLES IN TERMS OF MANIFOLDS. Lawrynowicz, J. (Polska Akademia Nauk, Lodz. Instytut Mathematyczny); Wojtczak, L. (Lodz Univ. (Poland). Instytut Fizyki). Z. Naturforsch., a; 29: No. 10, 1407-1417(Oct 1974).

21 refs.

The authors propose to explain the magnetic moment of elementary particles by a suitable choice of one pseudo-Riemannian

manifold—the space of observations—and two general Riemannian manifolds—the spaces of the particle connected with the external electromagnetic and nuclear fields. By a general Riemannian manifold the authors understand a Riemannian manifold whose associated tensor field is allowed to be degenerate. In this way the mass of a particle as well as its electromagnetic and nuclear properties is determined by means of manifolds and mappings between the corresponding Hilbert spaces. A nuclear reaction is then to be interpreted as a mapping between the corresponding pseudo-Riemannian manifolds and the associated general Riemannian manifolds. The proposal, competitive to the quantum field theory, presents a different way of describing the properties of physical objects. At the moment it is difficult to decide whether this proposal will lead to a satisfactory explanation of more physical phenomena than those explained by means of the quantum field theory, since it needs further research. (auth)

31707 CORRESPONDENCE BETWEEN CLASSICAL AND QUANTUM ENERGY STATES IN STATIONARY GEOMETRIES. Damour, T. (Princeton Univ., NJ). Lett. Nuovo Cim.; 12: No. 9, 315-318(1 Mar 1975).

The existence of positive- and negative-root solutions for a test particle moving in the field of a Kerr solution and their very important role with respect to reversible and irreversible transformations, and that these states should be considered as the classical limit of the positive and negative solutions of the Klein–Gordon equation were previously noted. It is pointed out that these results can be made manifestly clear by the consideration of a suitable choice of the coordinate system. This coordinate system however presents some disadvantages to carry out concrete computations. (JFP)

31708 RENORMALIZATION GROUP: A SOLVABLE MODEL. Coullet, P.; Tirapegui, E. (Univ., Nice). Lett. Nuovo Cim.; 12: No. 9, 303-308(1 Mar 1975).

The property of invertibility of the coupling constant recognized as the fundamental postulate for a global approach to renormalization group techniques is discussed. A nontrivial solvable model is presented in which the validity of this postulate can be studied. (JFP)

31709 STUECKELBERG FORMALISM FOR SPIN TWO. Delbourgo, R.; Salam, A. (Imperial Coll. of Science and Tech., London). Lett. Nuovo Cim.; 12: No. 9, 297-299(1 Mar 1975).

The Stueckelberg formalism is generalized for spin two, and it is shown that the Stueckelberg variant of a massive spin-two field in interaction with a current is strictly equivalent to the original Fierz-Pauli theory only if the current satisfies a given subsidiary relation. (JFP)

31710 BUBBLE GRAPH SUMS IN SUPERFIELD THEORIES. Delbourgo, R. (Imperial Coll. of Science and Tech., London). Lett. Nuovo Cim.; 12: No. 9, 293-296(1 Mar 1975).

The discussion of bubble graph sums in superfield theories includes the summation of the bubble supergraphs in which the space-time structure is purely S wave and sets of supergraphs. (JFP)

31711 CONSIDERATIONS ON ELECTRODYNAMICS, THE ETHER, GEOMETRY AND RELATIVITY. Einstein, A. Paris, France; Gautheir-Villars (1972). 153p. (In French). INIS.

This book contains several articles by Einstein translated from either German or English. The first entitled: On the Electrodynamics of Bodies in Motion was published in 1905 in Annalen der Physik v. XVII 1905 and the second: Does the Inertia of Body Depend on its Energy Capacity, in Annalen der Physik v. XVII, 1905. Ether and the Theory of Relativity is the title of a conference given at Leyde on May 5th, 1920. The article headed Meaning of Relativity was translated from the English and follows the publication in 1925 of "Four lectures on the theory of relativity given at the University of Princeton". (NL)

31712 GAUGE TRANSFORMATIONS OF SECOND TYPE AND THEIR IMPLEMENTATION. 2. Bosons. Gille, J. F. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique); Manuceau, J. (Aix-Marseille-1 Univ., 13-Marseille (France)). Ann. Inst. Henri Poincare, Sect. A; 20: No. 3, 297-313(1974).

A necessary and sufficient condition for implementation of some local gauge transformations in a class of irreducible representations of the C. C. R.-algebra (Weyl algebra) is proved. Not all of the pure states induced by these representations are unitarily equivalent to physically pure states; it is shown that a state of the class we consider is unitarily equivalent to a physically pure one if and only if a certain property (characterizing the discrete states) holds. Unlike the fermion case, they are quasi-free states which are not discrete. The discrete quasi-free states are all equivalent the only Fock state of this class. (auth)

31713 RENORMALIZATION CONSTANTS IN ASYMPTOTICALLY FREE FIELD THEORIES. Hirayama, M. (Toyama Univ., Japan). Lett. Nuovo Cim.; 12: No. 10, 329-333(8 Mar 1975).

The model that the massless Yang–Mills fields interact with massless fermion fields via the gauge invariant coupling is considered. A previous method is simplified and the analysis extended. It is found that the renormalized constant of the fermion–fermion–gauge–boson vertex and e and f are the group-theoretical constants given. It is noted that the gauge theoretical versions of the colored quark model, Han-Nambu model, etc. belong to the case $e > 0$. (JFP)

31714 LIGHT FROM SOURCES MOVING FASTER THAN LIGHT. Lemke, H. (Strasse des Friedens, Freiberg i. B.). Lett. Nuovo Cim.; 12: No. 10, 342-346(8 Mar 1975).

Superluminal inertial frames S′, especially those in which the source of the light is at rest, are used to discuss light from sources moving faster than light. A discussion is given of a system that possesses properties given relative to S′, e.g., an accelerated charged tachyon that is a bradyon in S′ and its fields, which possess properties with respect to S′ determined by Maxwell electrodynamics. A hot radiating gas moving faster than light, i.e., a system that has properties known relative to S′ is also discussed. The properties of these systems relative to S′ follow in analogy to methods of usual classical physics after applying a superluminal Lorentz transformation to the properties of the systems relative to S′. (JFP)

31715 STATIC, SCALARLY CHARGED DUST. Wolk, I.; Teixeira, A. F. F.; Som, M. M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Lett. Nuovo Cim.; 12: No. 9, 319-320 (1 Mar 1975).

It is shown that the metric coefficient $g_{00} = \exp[|2S|]$ follows directly from the field equations in the case S is the long-range repulsive, scalar field produced by a static scalarly charged dust; and that the equality of densities of matter and scalar charge is also a consequence of the Einstein scalar equations. (JFP)

31716 SUPERFIELDS AND THE RENORMALIZATION GROUP. Shafi, Q. (Univ., Freiburg). Lett. Nuovo Cim.; 12: No. 9, 321-324(1 Mar 1975).

A renormalization group equation is written for the Wess–Zumino model by using the superfield concept. Also the same model is studied for the space–time dimension $d = 4 - \epsilon$ with ϵ small and positive. The anomalous dimension of the superfield (to lowest order in ϵ) is found to be large in contrast to the rather small value that was previously obtained for the scalar ϕ^4 interaction. (JFP)

31717 NONZERO-MASS ASYMPTOTIC LIMIT OF MASSIVE THEORIES. Bandelloni, G. (Univ., Genoa). Nuovo Cim.; 25A: No. 4, 549-554(21 Feb 1975).

A study is made of under what conditions the asymptotic limit of massive theories is not massless. In particular the case of the massive Thirring model with Padé approximants up to the second order, since in this model the treatment is simplest yet gives sufficient hints as to how the critical theory may be constructed even with a small coupling constant. (auth)

31718 SUPERFIELD PERTURBATION THEORY AND RENORMALIZATION. Delbourgo, R. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 25A: No. 4, 646-656(21 Feb 1975).

The perturbation theory graphs and divergences in supersymmetric Lagrangian models are studied by using superfield techniques. In super ϕ^3-theory very little effort is needed to arrive at the single infinite (wave function) renormalization counter-term, while in ϕ^4-theory the method indicates the counter-Lagrangians needed at the one-loop level and possibly beyond. (auth)

31719 QUANTUM ELECTRODYNAMICS IN THE PRESENCE OF DIELECTRICS AND CONDUCTORS. I. Electromagnetic-Field Response Functions and Black-Body Fluctuations in Finite Geometries. Agarwal, G. S. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., A; 11: No. 1, 230-242(Jan 1975).

A form of quantum electrodynamics is developed which allows one to treat a number of problems involving dielectric and conducting surfaces, the presence of which leads to a number of new

observable effects. A number of suitably defined response functions play a basic role in the present approach, as these in conjunction with the fluctuation-dissipation theorem lead to electromagnetic field correlation functions, which describe physical effects such as lifetimes, frequency shifts of the excited states, dispersion forces, etc. The quantization of the electromagnetic field is only implicitly used. A large part is devoted to the calculation of the response functions involving different geometries and various types of dielectrics. Both spatially dispersive and spatially nondispersive dielectrics are considered. The response functions are calculated using Maxwell's equations and the usual boundary conditions at the interface adjoining the two mediums. As a first application of the present approach, the black-body fluctuations in finite geometries and the influence of surfaces on its temporal and spatial coherence are studied. An interesting theorem is also proved which enables one to calculate the normally ordered (antinormally ordered) correlation functions from the symmetrized correlation functions. (auth)

31720 QUANTUM ELECTRODYNAMICS IN THE PRESENCE OF DIELECTRICS AND CONDUCTORS. II. Theory of Dispersion Forces. Agarwal, G. S. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., A; 11: No. 1, 243-252(Jan 1975).

The different kinds of response functions introduced previously are used to calculate the dispersion forces. An exact expression for the interaction energy in a system of harmonic oscillators interacting with a second-quantized radiation field is obtained in terms of appropriate response functions. The radiation field may be either the field appropriate to entire free space or the field altered by the presence of the dielectric. The result is valid for arbitrary geometries involving dielectric and conducting surfaces. An expansion of the result in powers of e^2 leads to the results of others. The calculation of the dispersion force for the case of excited states is also briefly discussed. Next the problem of the dispersion force between macroscopic bodies is considered. Lifshitz's expression for the dispersion force is rederived using the response functions, and the two methods are compared. The role of surface modes in the determination of dispersion force is discussed. Finally the dispersion force between a spatially dispersive and spatially nondispersive dielectric is calculated exactly. When the spatial dispersion is weak, then it is found that the first-order term is repulsive in nature, in contrast to the zeroth-order term which is attractive. As a by-product of our analysis, surface-polariton dispersion relations are obtained. (auth)

31721 QUANTUM ELECTRODYNAMICS IN THE PRESENCE OF DIELECTRICS AND CONDUCTORS. III. Relations Among One-Photon Transition Probabilities in Stationary and Nonstationary Fields, Density of States, The Field-Correlation Functions, and Surface-Dependent Response Functions. Agarwal, G. S. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., A.; 11: No. 1, 253-264(Jan 1975).

The physical entities such as transition probabilities and the density of states are related to appropriate electromagnetic-field correlation functions and to appropriate response functions. Such response functions were already computed previously and therefore these can be used to obtain surface-dependent corrections. It is shown how the density of states and hence Planck's law depends on the presence of surfaces. The correction terms are explicitly calculated for the case of a small blackbody bounded by two plane conducting surfaces. An appreciable correction occurs if the linear dimensions of the blackbody are of the order of a wavelength. Next electric-dipole-type transitions in atomic systems are considered and a straightforward perturbation theory is used to obtain one-photon transition probabilities in terms of the surface-dependent response functions. As an illustration of the surface-dependent terms, the transitions in presence of a conducting surface are considered. The transition probabilities show a marked increase or decrease depending on whether the dipole transition is parallel or perpendicular to the surface. Both stationary and nonstationary fields are considered. As a special case of nonstationary fields, the transitions in a coherent field are considered in detail. It is also shown how the coherent radiation field in presence of dielectrics can be realized. It is found that if the radiation field, in arbitrary geometries, is initially in vacuum state then at later times it would be found in a coherent state if perturbed by an external (c-number) electromagnetic field. (auth)

Gravitation and General Relativity

Refer also to abstract 31704.

31722 (JINR-P2-8570) HIGH-ENERGY SCALAR PARTICLE SCATTERING IN GRAVITATIONAL FIELD. Nguyen Suan Han. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Closed expressions for the Green function and for the amplitude of the scalar particle scattering in the external gravitational field $g_{\mu\nu}(x)$ are found in the form of functional integrals. It is shown that, as compared with the scattering on vector potential, the tensor character of the gravitational field leads to a more rapid increase of the cross section with increasing energy. Discrete energy levels of particles are obtained in the Newton potential. (auth)

31723 PALATINI VARIATIONAL PRINCIPLE. Ray, J. R. (Clemson Univ., SC). Nuovo Cim.; 25B: No. 2, 706-710(11 Feb 1975).

A detailed discussion of the Palatini variational principle is presented. It is shown how the Palatini variational principle can be derived from the more general Hilbert variational principle. The main purpose is to explain the origin of the Palatini variational principle in a logical way instead of stating it as an ad hoc result as is usual. (auth)

31724 STRONG AND WEAK GRAVITY: A CLASS OF GENERALLY COVARIANT MIXING MODELS OF SPIN-2 NEUTRAL FIELDS: LINEARIZATION. Hammel, W. C. (Univ. of Wisconsin, Milwaukee). Nuovo Cim.; 25B: No. 2, 757-785(11 Feb 1975).

By linearizing, in an unorthodox way, the nonlinear partial differential equation system proposed to describe the interaction of a massless and massive graviton, it is discovered that the equations yield a variety of theories with different structure. The general system of equations which results from this linearization is a Lorentz-covariant system of coupled equations in two symmetric Lorentz tensor fields. One distinguishes between situations where the system may be uncoupled by a linear transformation of the tensor fields, thus permitting the definition of diagonalizing fields, and those situations where this is not possible. The diagonalizable cases are examined for mass and spin structure, and are divided into perturbative and nonperturbative cases. One of the perturbative cases contains the theory of Aichelburg and Mansouri. Finally the procedure for solving the explicitly coupled equations is described. (auth)

31725 MASSLESS SPINNING TEST PARTICLES IN A GRAVITATIONAL FIELD. Mashhoon, B. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Ann. Phys. (N.Y.) 89: No. 1, 254-257 (Jan 1975).

The classical equations of motion of a massless spinning test particle are derived as a limiting case of Mathisson—Papapetrou equations. It is shown that, when a particular supplementary condition is assumed, the particle follows a null geodesic and the spin is either parallel or antiparallel to the direction of motion. Moreover, the helicity is conserved in an orientable spacetime. The equations of the propagation of the momentum vector and the spin tensor along the trajectory are given, and further implications of the solution are discussed. (auth)

31726 CLASSICAL GENERAL RELATIVITY DERIVED FROM QUANTUM GRAVITY. Boulware, D.G. (Physics Department, University of Washington, Seattle, Washington 98195); Deser, S. Ann. Phys. (N.Y.) 89: No. 1, 193-240 (Jan 1975).

The existence of long-range macroscopic attractive forces between masses implies the existence of a mediating helicity ± 2 particle in special relativistic quantum particle theory. It is shown that this fact, alone, without assuming the existence of an underlying tensor field, uniquely determines the long-wavelength structure of quantum gravitation to be that of Einstein's theory. This equivalence is shown by deriving, from the Ward identities associated with the graviton propagator, the tree graph structure of the graviton—graviton and graviton—matter interaction and establishing that the classical Einstein action is the generating functional. Some properties of closed loop effects are also exhibited. (auth)

31727 STUDIES IN THE KERR—NEWMAN METRIC. Bose, S.K. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). J. Math. Phys. (N.Y.) 16: No. 4, 772-775 (Apr 1975).

The Kerr—Newman metric is analyzed according to the null tetrad formalism. The components of the Weyl and the Ricci tensors are calculated, and these tensors are then projected on a suitable null—tetrad basis. The spin coefficients of Newman and Penrose are also calculated. These results are applied to obtain the equations of gravitational and neutrino perturbations in the Kerr—Newman metric. (auth)

31728 KILLING INEQUALITIES FOR RELATIVISTICALLY ROTATING FLUIDS. Hansen, R.O.; Winicour, J. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). J. Math. Phys. (N.Y.) 16: No. 4, 804-808 (Apr 1975).

For rigidly rotating fluids in general relativity, it is shown that the angular momentum density is everywhere positive. This result depends

on a global inequality satisfied by the Killing scalars. The inequality follows, via the Hopf theorem, from an elliptic equation (essentially one of the field equations) on the scalars. A derivation of the field equations in terms of the manifold of Killing orbits is presented. Possible generalizations of the result to systems with differential rotation or interior event horizons are discussed. (auth)

31729 EXACT SOLUTIONS TO EINSTEIN FIELD EQUATIONS. Melnick, J. (Departamento de Astronomia, Universidad de Chile, Santiago, Chile); Tabensky, R. J. Math. Phys. (N.Y.) 16: No. 4, 958-960 (Apr 1975).

A method of generating static and isotropic solutions of the Einstein field equations is presented for the case in which the source of the field is a perfect fluid. A special case is exhibited. The general solution for vacuum is derived. (auth)

31730 CONFORMALLY FLAT SOLUTIONS OF THE EINSTEIN–MAXWELL EQUATIONS FOR NULL ELECTROMAGNETIC FIELDS. McLenaghan, R.G. (Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, Canada); Tariq, N.; Tupper, B.O.J. J. Math. Phys. (N.Y.) 16: No. 4, 829-831 (Apr 1975).

The spin coefficient formalism of Newman and Penrose is employed to obtain a direct derivation of the most general conformally flat solution of the source–free Einstein–Maxwell equations for null electromagnetic fields. (auth)

31731 SOME RESTRICTIONS ON ALGEBRAICALLY GENERAL VACUUM METRICS. Brans, C.H. (Joseph Henry Laboratories, Physics Department, Princeton University, Princeton, New Jersey 08540). J. Math. Phys. (N.Y.) 16: No. 4, 1008-1010 (Apr 1975).

Vacuum Einstein metrics of Petrov type I, general, are considered. It is shown that the only solution of this sort in which one of the Petrov scalars is zero is the trivial flat–space one. Further, it is shown that the point at which the four Petrov scalars vanish simultaneously (zero curvature tensor) cannot be included as a regular point of a neighborhood over which the scalars are functionally independent. In fact, for type I all derivatives of the Petrov scalars must vanish at a point at which the curvature tensor does so that this point cannot be a regular point of any nontrivial analytic solution. (auth)

31732 ON THE "DERIVATION" OF EINSTEIN'S FIELD EQUATIONS. Yilmaz, H. (Perception Technology Corporation, Winchester, Massachusetts 01890). Am. J. Phys. 43: No. 4, 319-322 (Apr 1975).

It is shown that the conventional correspondence procedure used in the transition from Newtonian to the Einsteinian theory of gravitation is not unique. A new procedure of correspondence whereby the theory is required to reduce to a special relativistic limit before it reduces to the Newtonian limit is described. It is shown that the special relativistic correspondence leads to first and second order requirements, whereas the Newtonian correspondence leads only to first order requirements. The resulting theory is logically plausible and experimentally viable. (auth)

31733 RADIATION REACTION AND MASS RENORMALIZATION IN SCALAR AND TENSOR FIELDS IN LINEARIZED GRAVITATION. Barut, A. O.; Villarroel, D. (Univ. of Colorado, Boulder). J. Phys., A (London); 8: No. 2, 156-159(Feb 1975).

The analytic continuation of the equation of motion provides a simple method to obtain the radiation reaction force and mass renormalization in classical field theories as an alternative to the energy-momentum tensor method. The coefficient of the Abraham factor is $+1/3$, $2/3$, $-11/5$ for the scalar, vector, tensor fields, and linearized gravitation, respectively. (auth)

31734 EINSHTEINOVSKII SBORNIK, 1973. (Einstein Collection, 1973). Ginzburg, V. L. (Ed.). Moscow; Izdatel'stvo Nauka (1974). 421p.

A series of 14 articles first appearing in various scientific journals and dealing with various aspects of the general theory of relativity and the special theory of relativity are compiled. (JSR)

31735 DIRECTIONAL SINGULARITIES OF THE "ROD SOLUTION" IN EINSTEIN–MAXWELL–YUKAWA FIELDS. Datta, D. K.; Rao, J. R. (Indian Inst. of Tech., Kharapur). J. Phys., A (London); 8: No. 2, 190-194(Feb 1975).

The generalized "rod solution" of Einstein–Maxwell–Yukawa fields is obtained and the directional behavior of the singularities is discussed. The solution obtained exhibits directional singularities for combined zero-mass scalar meson and electromagnetic fields under certain conditions on the parameters. It was observed that the presence of a source-free electromagnetic field does not affect the directional behavior of the singularities when only a zero-mass meson field is present. This has been investigated by Gautreau (Nuovo Cim.; B62: 360-70 (1969)). (auth)

31736 TETRAD APPROACH TO CHARGED FLUID MOTION IN THE EINSTEIN–MAXWELL THEORY. Woolley, M. L. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Proc. Roy. Soc. (London), Ser. A; 342: No. 1628, 79-91(25 Feb 1975).

By projecting the fluid flow vector on to a unique tetrad of eigenvectors of the electromagnetic part of the energy-momentum tensor, the Einstein–Maxwell equations for a charged fluid spacetime in four dimensions may be simplified and reduced to a system which determines the functional dependence of the eigenvectors. This is achieved by replacing the Riemannian connection $\Gamma^{\sigma}_{\mu\nu}$ with the Ricci rotation coefficients γ^{a}_{bc} which describe the tetrad geometry. In the anholonomic reference system of the tetrad it is shown that the fluid flow vector has at most two nonzero components u^1, Maxwell's equations appear as linear relations between the γ^{a}_{bc}, and the equations of motion of the source consist of one differential relation and three algebraic relations between the γ^{a}_{bc} and the u^1. As an example, the problem of determining a time-dependent magneto-sonic-gravitational wave is shown to be reducible to that of solving a well known type of nonlinear second order ordinary differential equation. (auth)

31737 IMPROVEMENTS IN THERMAL ENERGY: ELECTRICAL ENERGY CONVERTER CAPABLE OF DELIVERING A RELATIVELY HIGH VOLTAGE. Lalaurie, J. (to Thomson-CSF). French Patent 2,177,526/A/. 28 Mar 1972. 10p. (In French).

The thermal-to-electrical energy converter comprises a plurality of series-mounted converter members capable of delivering the electrical energy at high voltages. Said converter members are stacked in a tight cylindrical enclosure. Collector of one of these members and emitter of the next member in the stock form the two opposite sides of a tight space containing a nuclear fuel rod which heats the emitter. Cesium vapor flows between the electrodes. The assembly of the converter is achieved with as few ceramic-metal tight connections as possible. The various converter members may be connected either in series, series-parallel or parallel fashion. (FR)

31738 THEORETICAL ASPECTS OF THE GRAVITATIONAL RADIATION. Linet, B. (Centre National de la Recherche Scientifique, 75-Paris (France)). Rev. Cethedec; 11: No. 38, 45-77(1974). (In French).

A survey is made of the important concepts of gravitational radiation in Einstein's theory of gravitation from a theoretical point of view. (FR)

31739 GEOMETRIZATION OF RELATIVISTIC MECHANICS OF CONTINUOUS MEDIA WITH SPIN DENSITY. Crumeyrolle, A. (Toulouse-3 Univ., 31 (France)). Ann. Inst. Henri Poincare, Sect. A; 20: No. 3, 221-236(1974). (In French).

A trial of geometrization of relativistic schemes is presented, welding together Einstein's gravitational, Maxwell's electromagnetic fields and some spinning continuous media. The geometric setting is the tangent bundle over space-time (state space or phase space) endowed with a particular pseudo-euclidean connexion. In the symmetric case, equations ruling gravitation and spin effects and the law of motion generalizing that of GR and relativistic models are obtained. Likewise, in asymmetric case appear equations describing gravitation, spin density and maxwellian field. (FR)

31740 MOTION EQUATIONS IN A MINKOWSKI GRAVITATIONAL THEORY. Bilialov, R. F. (Paris-6 Univ., 75 (France). Inst. Henri Poincare; Kazanskij Gosudarstvennyj Univ. (USSR)). Ann. Inst. Henri Poincare, Sect. A; 20: No. 3, 257-267(1974). (In French).

A new method for obtaining Lorentz-Dirac equations in electrodynamics is presented. This method is applied to motion equations in a Minkowski gravitational theory which is described by the symmetrical tensor $PSI_{\alpha\beta}$ with the condition $\delta^{\alpha} PSI_{\alpha\beta} = 0$. (FR)

31741 CONFORMAL UNIQUENESS AND VARIOUS FORMS OF THE SCHWARZSCHILD INTERIOR METRIC. Guerses, M. (Yale Univ., New Haven); Guersey, Y. Nuovo Cim.; 25B: No. 2, 786-794(11 Feb 1975).

The Schwarzschild interior solution is known to have a conformal structure. It is shown that it is the only solution of Einstein's equations which is static and conformally flat for a spherically symmetric perfect-fluid distribution. Its homogeneous limits are exhibited as cosmological metrics and the explicit coordinate transformations associated with the conformal mapping to these cosmological spaces are given. Comoving coordinates and matching to the exterior metric are also discussed. (auth)

REACTOR TECHNOLOGY AND REGULATION

31742 NUCLEAR REACTOR WITH INTEGRATED HEAT EXCHANGERS. Ventre, E. (to Electricite de France). Canadian Patent 951,032. 9 Jul 1974.

The reactor comprises within a leak-tight vessel a number of reactor cores disposed in a circle on a supporting platform, a fuel-handling device mounted above one of the cores, a heat-exchanger suspended above each of the remaining cores, a central column rigidly fixed to the core supporting platform and extending through the entire reactor vessel. The central column is coupled at a point located outside the reactor vessel to a system for carrying out the rotary displacement of the column about its own axis and thus causing the rotary displacement of the reactor cores so as to bring each core in turn from the normal operating position beneath a heat exchanger to the refuelling position beneath the fuel handling device. (CA)

31743 MODULAR FUEL-COOLANT CAPSULE REACTOR. Howieson, J.; Stubley, P. H. (to Westinghouse Canada Ltd.). Canadian Patent 950,135. 25 Jun 1974.

A nuclear reactor is assembled from a plurality of enclosures, each enclosure containing a fuel element and a fuel coolant material. The enclosure has a portion which protrudes out of the reactive portion of the reactor and is in heat exchange relationship with a working fluid. The inter-relationship between the enclosure and the working fluid is such that the enclosure may be removed without interfering with the working fluid circuit. The cooling fluid within the enclosure is vaporized by the heat generated in the fuel and is condensed by its heat exchange relationship with the working fluid. By utilizing the natural separation of the vapor phase from the liquid phase of the coolant as a driving force, the problems of transporting vaporizable material are substantially reduced. By suitable selection of the coolant, it may be possible to allow the coolant to contact directly the fuel thus increasing the efficiency of heat transfer and eliminating the problems of fuel encapsulation. (CA)

31744 NUCLEAR REACTOR COOLED BY A LIQUID MODERATOR. Zmola, P. C.; Rickert, R. J. (to Combustion Engineering, Inc., Windsor, Conn. (USA)). German(FRG) Patent 1,639,170/C/. 26 Apr 1973. 17p. (In German).

22 figs.

A reactor is described in which the core is made up from fuel element arrangements which are constructed from tubes whose sides are spaced from one another such that some regions of the arrangements exhibit a considerably higher power density than others. In some arrangements, coolant flows through the tubes which have wall openings through which the coolant can flow sideways into the regions of higher power density. A description is given of the arrangement of the tubes and the openings and the distribution of control rods and fuel elements. (GE)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 32188, 32212, 32215, 32217–32219, 32334, 32335, and 32340.

31745 (AECL-5013) STEAM GENERATOR TUBE FAILURES: WORLD EXPERIENCE IN WATER-COOLED NUCLEAR POWER REACTORS IN 1973. Stevens-Guille, P. D.; Hare, M. G. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1975. 17p. Dep. NTIS (U. S. Sales Only) $4.00. AECL $0.50.

Eleven of 49 water-cooled reactors experienced failures of steam generator tubes in 1973. These failures are summarized. Corrosion and vibration were the main causes. Secondary-water chemistry and design are the two most important aspects in preventing tube failures. (23 references) (auth)

31746 (AED-CONF-74-571-015) THE ECONOMICS OF PLUTONIUM RECYCLE IN LIGHT WATER REACTORS IN THE UNITED STATES. Hanrahan, E. J. (USAEC Office of Planning and Analysis, Washington, D. C.). 1974. 4p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F.R. Germany (25 Nov 1974).

Some of the factors which affect the economics of plutonium recycle in light water reactors in the United States are examined. Some of the major factors analyzed are the value of plutonium in terms of natural uranium and separative work, fuel fabrication and reprocessing costs. The purpose is to identify those situations which act as an incentive for plutonium recycle as well as those situations which act as a disincentive. The time frame for this analysis is the next 15 to 20 years with the implicit assumptions that light water reactors operate as baseloaded electrical generating plants and plutonium recycle is permitted by regulatory authorities. (auth)

31747 (COO-651-93) FINAL ELK RIVER REACTOR PROGRAM REPORT. (United Power Association, Elk River, Minn. (USA)). Nov 1974. Contract AT(11-1)-651. 123p. Dep. NTIS $5.45.

Reactor dismantling activity specifications are presented together with post-dismantling analyses of the dismantling operations. (DG)

31748 LOCKING DEVICE FOR A LOW PRESSURE PIPING CONNECTED TO A HIGH PRESSURE LINE, ESPECIALLY FOR WATER-COOLED NUCLEAR POWER INSTALLATIONS. (to Siemens AG). Netherlands Patent 7,205,724. 27 Apr 1972. 6p. (In Dutch).

The invention provides a locking device, for low-pressure pipings connected to high-pressure circuits, especially for water-cooled nuclear power installations. (NL)

31749 RETROFITTING AN OPERATING NUCLEAR POWER PLANT: MILLSTONE N. P. S. UNIT 1 RADWASTE MODIFICATION. Watson, P. D.; Doyle, R. D. 74-WA/NE-1. New York; American Society of Mechanical Engineers (1974). 9p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

When Northeast Utilities decided to reduce radioactive effluent discharges from Millstone NPS Unit 1, it was determined that a coordinated modification of five plant systems would be required. In 1971, EBASCO was hired as the engineer-constructor for this work which has since progressed to near completion. To date, only portions of the modified systems have been operated, and it is expected that the original design criteria will be met. (auth)

31750 CRYOGENIC DISTILLATION: AN OPTION FOR OFF-GAS TREATMENT. Schmauch, G. E. 74-WA/NE-2. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Cryogenic distillation provides an attractive option for the treatment of off-gas from a BWR power station. A system that was designed and fabricated by Air Products and Chemicals, Inc. is described. This system is based upon proven technology that is currently practiced throughout the industrial gas industry. It can be operated as a radioactive noble gas delay system or as a collection and storage system. The collected rad-gas can be stored indefinitely or it can be released after decay, at a controlled rate when meteorological conditions are appropriate. This versatility provides insurance for the future when more stringent restrictions on release levels may be imposed. The system is constructed in three modular sections to minimize space requirements and field installation. The economic aspects of the system are described to allow comparison with alternate off-gas treatment methods. (auth)

31751 RECURRENT PRESSURE TEST ON THE CONTAINMENT OF THE NUCLEAR POWER PLANT AT LINGEN. Beyer, H. (Kernkraftwerk Lingen G.m.b.H., Darme/Lingen (F. R. Germany)). VGB Kraftwerkstechnik; 54: No. 12, 810–816(Dec 1974). (In German).

3 figs.

Lingen nuclear power plant operational requirements include demonstration by regular tests that the actual containment leak rate is below the permissible maximum. The first recurrent leak rate test was carried out in August 1970. The results are reported. (GE)

31752 EQUIPMENT AND PROCEDURE FOR THE DETERMINATION OF DEFECTIVE FUEL RODS IN NUCLEAR REACTORS. Jones, C. R. (to Transfer Systems, Inc., North Haven, Conn. (USA)). German(FRG) Patent 2,249,721/S/. 26 Apr 1973. 29p. (In German).

7 figs.

Equipment is described which allows the removal of a fuel element bundle with its coolant, the heating of fuel rods to a high temperature, and the removal of a coolant sample for examination for the presence of radioactive substances typical of defective fuel rods. A detailed description is given of the necessary technical details to fulfill these tasks (grab, seal, guides, etc.). (GE)

31753 DESIGN CONSIDERATIONS FOR NUCLEAR CONTAINMENT FILTER-COOLER SYSTEMS. Rivers, R. D.; York, J. D. (American Air Filter Co., Inc., Louisville, Ky.). pp 419-436 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The prime function of filtration systems for water cooled reactors is to trap and hold radioactive contaminants, thus reducing to the lowest possible values releases from stacks or through containment shell leaks. The basic filter elements-HEPA filters and adsorption beds are fragile and sensitive to environmental conditions, especially those expected in loss-of-cooling accidents (LOCA). Such filter systems must therefore include devices to remove heat, water vapor, and water droplets. Design procedures for assuring that system elements (fans, filters and cooling coils) are adequately and optimally sized are discussed. Test facilities and procedures for checking the performance of these and other filter-cooler system components under simulated LOCA conditions are also described. (FR)

31754 FISSION PRODUCT RELEASE FROM DEFECTIVE FUEL ELEMENTS. Rousseau, L.; Japavaire, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service d'Etudes de Surete Radiologique). pp 159-184 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French)

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The origin and transfer mechanisms of the radioactivity released following a clad failure in normal operation or in the conditions during an hypothetical accident (in particular loss-of-coolant) are examined. The following points are then studied: quantities of fission products present in the core, classified according to their importance with regard to the radiological safety; conditions of coolant contamination; new proposed solutions to improve element characteristics in order to minimize defective clads and the quantity of fission products released and minimize evaluation of released activities from the core to the nuclear plant environment. (FR)

31755 TECHNICAL TRADE-OFFS IN DESIGNING EVAPORATORS FOR NUCLEAR POWER STATIONS. Bidwell, G. P. 74-WA/NE-7. New York; American Society of Mechanical Engineers (1974). 7p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Evaporators serve two purposes in nuclear power plants: (a) process waste and recover boric acid for reuse in PWR stations, and (b) concentrate waste in preparation for disposal in both PWR and BWR stations. Boric acid is used in the primary loop of a PWR plant as a chemical shim to control the nuclear reaction. The quantity of boric acid required to control the reaction varies during the core life, and "evaporation" is employed to remove boric acid from the reactor coolant as the core ages. Dilute radioactive waste solutions are accumulated from various sources during normal operations. These wastes are processed in an "evaporator" to remove water and consolidate the waste material for disposal. The technical trade-offs encountered in the design of evaporators are discussed. Effectiveness, safety, equipment configuration, system operations, and utility requirements must be considered. Each of these factors impose limitations on the others and must be consolidated into the overall design. (auth)

31756 OFFGAS SYSTEM OPTIMIZATION. Stewart, J. E.; Desai, A. M. 74-WA/NE-6. New York; American Society of Mechanical Engineers (1974). 11p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Electric utilities are making great strides to reduce emission of gaseous radioactivity from nuclear electric generating plants. The most commonly accepted processes to attenuate the radioactivity from noble gases in the offgas effluents from both PWR (Pressurized Water Reactor) and BWR (Boiling Water Reactor) systems are described. The objective is to design a system which limits the radiation dose to the general public "as low as practicable." This is interpreted to be in accordance with the International Commission for Radiological Protection, the AEC Regulatory Guides and the Code of Federal Regulations and yet be practical on a cost-benefit basis. The BWR uses the following basic steps in treating the offgas: steam or air dilution, preheating, recombination, moisture removal, noble gases retention by delay in charcoal beds or by removal with cryogenic distillation. The block and flow diagrams show alternate methods of packaging these systems and economic impact for both operation and installation. For PWR, two basic systems are described compressed gas storage and catalytic recombination followed by a delay system. Design charts are presented for cost comparison, system optimization, and component selection. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 31745, 31746, 31748, 31752–31756, 32184–32187, 32196, 32199, 32212, 32214, 32215, 32217–32219, 32221, 32224, 32230, 32231, 32261, and 32336–32339.

31757 (AED-CONF-74-555-002) THREE-DIMENSIONAL STRESS ANALYSES OF THE BIBLIS A MAIN COOLANT JUNCTION. Miksch, M.; Schmitt, W. (Kraftwerk Union A. G., Erlangen (F.R. Germany)). 1974. 39p. (In German). INIS.

From finite element congress; Baden-Baden, F.R. Germany (18 Nov 1974).

32 figs.; 7 refs. With abstract in German and English. Available from ZAED.

An exact stress analysis of the main coolant junctions and supporting flange rings of a reactor pressure chamber is, because of the geometry involved, difficult to formulate. Stress analyses were implemented for a selected main coolant junction (Biblis A) using two well-known programs, ASKA and MARC. Two different models were set up: in the ASKA model, the flange ring was fully described; in the MARC model, the flange ring was taken as symmetric, and only the upper half was idealized. The results of both calculations are shown and compared. (auth)

31758 (WAPD-MRP-143) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, July 26, 1974–January 25, 1975. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). 1975. Contract AT(36-1)-GEN-14. 16p. Dep. NTIS $4.00.

Shippingport PWR Core 2, Seed 2 has remained shutdown since February 4, 1974 following a failure of the main unit turbine generator. Defueling of PWR-2 was initiated with control rod drive mechanism seal weld cutting, mechanism motor tube removal, and cutting of instrumentation nozzles on the core support flange currently in progress. Plant conditions are being maintained to support the defueling operations. The 1A, 1C, and 1D loops are isolated from the reactor vessel and in a wet layup condition. The 1B loop is open to the reactor vessel, and the 1B loop, reactor vessel and pressurizer are in a partially drained condition. A nitrogen atmosphere is being maintained in the 1B loop and reactor vessel. Several plant related problems required resolution in anticipation of the future need to maintain the reactor vessel water level within a very small control band. (auth)

31759 (WCAP-8388) PERFORMANCE CHARACTERISTICS OF MIXED PuO_2–UO_2 FUELS IN PRESSURIZED WATER REACTORS. Rim, C. S.; Chubb, W.; Caye, T. E.; Argall, B. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Energy Systems Div.). Feb 1975. vp. Westinghouse Electric Corp., Pittsburgh, PA.

Usage of mixed PuO_2-UO_2 fuel in pressurized water reactors is expected to increase significantly in the near term. Physical properties and performance characteristics of mixed oxide fuel are presented. Comparisons with uranium dioxide fuel are included. Westinghouse plutonium utilization experience in operating pressurized water reactors (PWRs) is also summarized. Evaluation of nuclear and thermal-hydraulic core characteristics, and reactor safety analysis for core designs employing mixed oxide fuel assemblies are covered appropriately on a case by case basis. (49 references) (auth)

31760 (WCAP-8480) WESTINGHOUSE EMERGENCY CORE COOLING SYSTEM EVALUATION MODEL APPLICATION TO PLANTS EQUIPPED WITH UPPER HEAD INJECTION. Young, M. Y.; Vijuk, R. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Energy Systems Div.). Jan 1975. vp. Westinghouse Electric Corp., Pittsburgh, PA.

The Upper Head Injection (UHI) System, comprised of accumulator tanks and piping arrangement for supplying cooling water to the top of the core during the blowdown period following a postulated large-break loss-of-coolant accident (LOCA), has been designed by Westinghouse to provide additional core cooling beyond that supplied by the Westinghouse Emergency Core Cooling System (ECCS). With this additional core cooling based on experimentally determined heat transfer relationships, plant operation at higher core power peaking may be permitted. The modifications

made to the Westinghouse ECCS Evaluation Model, which meets the requirements of Appendix K 10 CFR 50, and the application of that model to determine system behavior in a PWR equipped with UHI during a LOCA are presented. Generic results of postulated large and small break accidents with UHI are analyzed. The effectiveness of the UHI system in cooling the core during an accident and the subsequent margin it provides with respect to the requirements set forth by the Appendix K is demonstrated. (13 references) (auth)

31761 IN-SERVICE INSPECTION OF THE VESSELS OF PRESSURIZED WATER REACTORS; EXAMINATION OF THE INSIDE USING ULTRASOUND. Saglio, R. (CEN de Saclay, Gif-sur-yvette, France). Metaux (Corros.-Ind.); 49: No. 585, 207-212(May 1974). (In French).

From meeting on welding metallurgy; Marseille, France (8 Nov 1973).

The techniques and apparatus developed by the section of the CEA concerned with advanced techniques for in-service inspection of PWR pressure vessels from the inside are presented. (FR)

31762 ULTRASONIC PRECISION CONTROL FOR BIBLIS REACTOR VESSEL. Atoomenergie Haar Toepass.; 17: No. 1, 10-11(Jan 1975). (In Dutch).

The technical design and operation of an ultrasonic control system used for precision measurements and adjustments in assembling the pressure vessel for the Biblis (1200 MW(e)) pressurized light-water reactor are described. The same ultrasonic system will also be employed for detailed monitoring of the pressure vessel for any structural changes and possible faults developing during its working life. (NL)

31763 EFFECTS ON CRITICAL HEAT FLUX OF LOCAL HEAT FLUX SPIKES OR LOCAL FLOW BLOCKAGE IN PRESSURIZED WATER REACTOR ROD BUNDLES. Hill, K. W.; Motley, F. E.; Cadek, F. F.; Casterline, J. E. 74-WA/HT-54. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The effects on Critical Heat Flux (CHF) of two fuel element abnormalities which can arise in pressurized water reactors were investigated. These are: (1) local heat flux spike of a magnitude conservatively representative of fuel densification effects; (2) an isolated flow blockage in the hot channel. Two separate series of tests were conducted using 14 ft long, 4 × 4 square array electrically heated rod bundles in a high pressure water loop. This study resulted in the following conclusions for rod bundles with Westinghouse mixing vane grids: (1) the effect of the spike on CHF was negligibly small, so that no reduction in CHF is indicated for spikes which can result from fuel densification; (2) the effect of a small isolated blockage can, for some conditions, slightly increase CHF. In any case, no deleterious blockage effect on CHF is indicated. 7 references. (auth)

31764 A SAFETY DEVICE FOR NUCLEAR PLANTS IN PARTICULAR POWER GENERATING PLANTS. (to Societe Babcock-Atlantique, 75-Paris (France)). French Patent 2,186,708 /A/. 31 May 1972. 16p. (In French).

Two-high-strength grids, located above and under the reactor vessel respectively are connected by means of fastening members adapted to be easily untightened for maintenance operations requiring direct access to the vessel. Vertically movable locking members fill the gap between the vessel and the concrete biological shield surrounding the latter, thus restricting or even preventing any axial, radial, or tilting movements of the vessel. This device can be applied to power generating nuclear plants built in inhibited areas. (FR)

31765 BEHAVIOR AND PHYSICAL-CHEMICAL STATE OF FISSION PRODUCTS IN FUEL ELEMENTS OF PWR TYPE REACTORS. Bazin, J.; Jouan, J.; Vignesoult, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Elements Combustibles et Structures). Bull. Inform. Sci. Tech. (Paris); No. 196, 55-71(Oct 1974). (In French).

The behavior of fission products in fuel rods of PWR type reactors was investigated using the analytical techniques available in the hot laboratory. The study was carried out on fuel elements irradiated in conditions similar to those in commercial power reactors or in very different conditions, in order to test the fuel up to utilization limits. The fission products present in the fuel elements were identified and located. The various compounds and alloys they form between each other or with the fuel were determined particularly with respect to the oxide-cladding reaction, for which an endeavor was made to define the conditions in which this reaction occurs, in terms of the irradiation conditions. (FR)

31766 COMPARISON OF PRESENT PLANS OF REACTORS: FAST, HTR, AND PWR IN REGARD TO THE CONFINEMENTS. Coste, G. (Societe Technique pour l'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). pp 307-314 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French)

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The designs planned by the TECHNICATOME or in joint-venture with other societies of nuclear engineering: Groupement Francais pour les Reacteurs a Haute Temperature for the HTR project (Gulf Atomic International licence), Groupement pour les Activites Atomiques et Avanceees (concerning Super PHENIX project), mainly in regard to the containment structures, are described. The main characteristics (pressure values and maximal leak flows; design and building to the containment vessels) are successively examined. In conclusion, a preference for a new type of containment vessel with double wall but without metal-coating, usable for light water reactors is underlined. (FR)

31767 FUEL ELEMENT DISPLACEMENT IN THE NUCLEAR SHIP "OTTO HAHN." Korte, K. H. (Siko - Siegel und Korte, Wurmberg (F. R. Germany)); Neumann, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). Werkstatt Betr.; 107: No. 3, 151-154(Mar 1974). (In German).

The technical preparations for the mechanical auxiliary means for fuel element displacement are described. The unlocking device, the separating tool for the core locking mechanism as well as the grab to manipulate the fuel elements are mainly dealt with. The extensive pretesting of the tools enabled a smooth fuel element displacement in autumn 1972. (auth)

31768 APPLICATION OF CHERENKOV DETECTORS FOR MONITORING CONCENTRATION OF THE FISSION PRODUCTS IN COOLING WATERS FOR NUCLEAR POWER PLANTS WITH PWR. Oravec, J.; Melichar, Z. (Vyskumny Ustav Energeticky, Jaslovske Bohunice, Czech.). Radioisotopy; 15: No. 6, 895-911 (1974). (In Czech).

On the basis of data available about nuclear power plants with PWRs, the applicability of Cherenkov detectors for monitoring of fission products in primary circuits, liquid radioactive wastes, and leakages from primary to secondary circuits is evaluated. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 31766, 32308, 32312, and 32313.

31769 (CEA-CONF-2847) H.T.R. PARTICULARLY DESIGNED FOR PROCESS APPLICATIONS. Malherbe, J.; Tilliette, Z. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). [nd]. 18p. (CONF-741144-3). Dep. NTIS (US Sales Only) $4.00.

From BNES international conference on the HTR process application; London, UK (26 Nov 1974).

Some core and arrangement problems are presented for HTGRs supplying mainly heat at a high temperature level and only a relatively small amount of electricity. In the first section core aspects are dealt with. The different means of achieving higher temperatures are investigated more particularly. Three stages of actions could lead to 1100°C or more. The second section is devoted to the reactor system and arrangement. Some basic principles which should be kept in mind are listed. An attempt to adopt them leads to a possible circuit configuration. Consequences on reactor arrangement are illustrated. It has been necessary to investigate separately reactors with metallic heat exchangers (900°C/950°C ?) and reactors with ceramic (graphite) heat exchangers (≥1000°C). (auth)

31770 (GA-A-13007) HTGR POWER DISTRIBUTIONS. Hamilton, C. J. (General Atomic Co., San Diego, Calif. (USA)). 31 Dec 1974. vp. (GA-LTR-18). General Atomic Co., San Diego, CA.

Supplemental data are presented on power distributions that occur in the reactor core during startup, normal operation, load changes and shutdown for large high-temperature gas-cooled reactors. The design objectives for power distributions, the fuel and burnable poison zoning requirements, and the control rod patterns used are also covered. Although the information deals primarily with the design of the 1160 MW(e) core, many

of the topics presented are generic in nature and directly applicable to the other core sizes. (28 references) (auth)

31771 (JUL-1053-RB) EXPERIMENTAL SET-UP FOR MEASURING RELEASE RATES OF SOLID FISSION PRODUCTS AND THEIR PLATE-OUT IN THE AVR REACTOR. Mehrens, H.; Gilli, R.; Niederhagen, K. H.; Muenchow, K. H.; Hinssen, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorbauelemente). Mar 1974. 50p. (In German). INIS.

For an assessment of the safety of high-temperature reactors, the knowledge of the release rate of gaseous and solid fission products and their behavior in the primary cooling gas of the reactor is of fundamental importance. The first investigations to clarify this problem cycle were started in the reactor experiment Dracule in Dragon. Similar to the construction of this experiment, the so-called gas-removal set-up Vampyr in the AVR was put into operation in 1972. The object of this experiment is for the determination of the concentration of the solid fission and activation products in the hot cooling gas of the AVR, and for the investigation of the plate-out mechanism of these nuclides on various materials under the realistic conditions of a high-temperature reactor. (GE)

31772 (JUL-1105-RG) INVESTIGATIONS OF POTENTIAL APPLICATION OF X-RAY FLUORESCENCE SPECTROMETRY FOR IDENTIFICATION AND CLASSIFICATION OF SPHERICAL FUEL ELEMENTS. Obi, F. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Aug 1974. 98p. (In German). Dep. NTIS (US Sales Only) $8.00.

Thesis. Submitted to Technische Hochschule Aachen, West Germany.

Investigations of the potential application of x-ray fluorescence spectroscopy for identification and classification of pebble-bed reactor fuel elements are described. Measurements were carried out on graphite spheres impregnated with different chemical elements at various concentrations. The intensity of the Kα-line of the impregnating elements, as function of concentration, was measured in order to establish the optimal concentrations needed for fuel element identification, and the sensitivity of the used spectrometer. These measurements have shown that x-ray fluorescence methods can be employed with advantage for identifying pebble-bed reactor fuel elements. There are enough, suitable chemical elements and a wide range of concentrations of each element, which may be used for this purpose. However, the sensitivity of the spectrometer was too low to detect the expected concentration of Sr and Cs (<1 ppm) resulting from "coated particle" damage. The use of pulsed x-ray tubes to excite the fluorescence lines was investigated and found unsuitable. More promising is the idea of exploiting the fission product γ-activity of the irradiated fuel element for exciting the characteristic x-ray lines of the impregnating elements. (auth)

31773 (ORNL-tr-2904) DEVELOPMENTS IN THE AREA OF NOISE THERMOMETRY AT KFA-JUELICH. Brixy, H.; Rittinghaus, K. F.; Gaertner, K. J.; Hecker, R. (CONF-741226-2). (Oak Ridge National Lab., Tenn. (USA)). 1975. Translated by H. H. Hubbell, Jr. (Oak Ridge National Lab., TN). 12p. Dep. NTIS $4.00.

With the development and construction of larger high-temperature reactors with exit gas temperatures of 950°C and above, there arises in increasing degree the demand for a method of measuring temperature which yields reliable temperature values after long working times and which can also be applied to in-core measurements. In principle this demand can be fulfilled by noise thermometry. The electronic equipment necessary for noise thermometry is described. (auth)

31774 THERMAL AND HYDRAULIC PERFORMANCE OF HIGH TEMPERATURE HELIUM GAS LOOP. Shimomura, H.; Kawamura, H.; Okamoto, Y.; Nakano, T.; Hagiwara, T.; Minami, R. 74-WA/HT-3. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A high-temperature helium gas facility for proof testing of HTGR components in helium under simulated reactor operating conditions has been constructed and tested at Japan Atomic Energy Research Institute. The HTGL is capable of circulating helium gas and testing HTGR fuel elements, heat exchangers and other components at temperature of up to 1000°C. During several phases of testing and operation, approximately 650 hr of the loop operation was accumulated successfully, 320 hr of which was at nominal design temperature of 1000°C. Thermal and hydraulic data are provided for a wide range of testing conditions. High-temperature performance of heater, regenerative heat exchanger, thermal insulator, purification system and piping structure is summarized and analyzed systematically. (auth)

31775 RADIATION EFFECTS ON HEAT TRANSFER IN REACTOR CORE AND HEAT EXCHANGERS OF HTGR. Mori, Y.; Hijikata, K.; Yamada, Y. 74-WA/HT-2. New York; American Society of Mechanical Engineers (1974). 13p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A general and fundamental study of the effect of radiation between duct walls on heat transfer performance of duct flows of non-radiative gas such as helium is made by an approximate analysis and numerical calculations. Laminar and turbulent flows in a duct simulating a coolant passage in HTGR and flows in counterflow and parallel-flow heat exchangers in the HTGR heat transfer system are investigated. An approximate analytical solution, based on the assumption that radiation from a point of duct wall produces the effect only on the narrow region opposing the point, agrees well with numerical results. The increase of radiative heat causes the decrease of temperature difference between the duct walls and improves the heat transfer performance. For heat exchangers the heat transfer effectiveness is shown to depend on three non-dimensional parameters and can be improved by the increase of these parameters. (9 references) (auth)

31776 COATED PARTICLE FUEL FOR NUCLEAR REACTORS AND TO THE MANUFACTURE OF SUCH FUEL. Freck, D. V. (to Central Electricity Generating Board). US Patent 3,866,043. 11 Feb 1975. Priority date 20 Apr 1970, United Kingdom of Great Britain and Northern Ireland. 4p.

Particle fuel, such as is used in high temperature nuclear reactors, and having the fuel material coated with a pyrolytic carbon coating impermeable to gaseous fission products and embedded in a matrix of graphite, incorporates radium 226 preferably in the binder for the grains of the fuel. The integrity of the pyrolytic carbon coating can then be checked before irradiation in a reactor by circulating an inert gas, e.g., argon, over the particles at a temperature in excess of 800°C, e.g., in the final carbonisation step during manufacture or immediately before vacuum degassing. The inert gas after passing over the particles is checked for the presence of radon 222, e.g., by passing the gas into a decay chamber having a filter in its outlet to collect radioactive solid daughters of radon and counting the alpha particles emitted by the material collected on the filter. (Official Gazette)

31777 CORE AUXILIARY HEAT EXCHANGER FOR A HIGH-TEMPERATURE GAS-COOLED REACTOR: WATER SIDE STATIC STABILITY ANALYSIS AND DESIGN. Carosella, D. P. Jr.; Harvego, E. A. 74-WA/HT-7. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The core auxiliary heat exhcanger for a High-Temperature Gas-Cooled Reactor (HTGR) operates over a large water flow range. Because the auxiliary heat exchanger must provide auxiliary core cooling (high water flow) and must remain operational during standby (low water flow), it is desirable to design the heat exchanger for inherent water-side static stability over its entire operating range. To achieve inherent static stability for standby mode operation (low water flow), the hydrostatic characteristics of a "U" tube are incorporated into the design layout. For the operational mode (large heat duty and water flow), inherent static stability is achieved by designing for subcooled operation during the worst combination of conditions. Also, to provide a design margin for the operating conditions, tube orifices are incorporated into the design. These orifices provide static stability for local heat input 35 percent greater than the worst-case conditions. (auth)

31778 THERMAL CONSIDERATIONS OF THE REGION BETWEEN THE CORE AND THE REACTOR VESSEL IN A GAS-COOLED REACTOR. Betts, W. S. Jr. 74-WA/HT-8. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

The thermal function and thermal characteristics of the region in a High-Temperature Gas-Cooled Reactor between the reactor core and the sidewall of the prestressed concrete reactor vessel are described. In this region several components and structures with different thermal, nuclear, and structural functions are present. The thermal model is detailed with a discussion of boundary conditions, material thermal conductivity, flow convection, radiation, and internal heat generation. The results include detailed temperature distributions of the reactor internals and thermal barrier during 100 percent rated power, and discussion of these results is presented. (auth)

31779 PERMEATION FLOW AND HEAT TRANSFER IN THE HTGR THERMAL BARRIER. Baxi, C. B.; Del Bene, J. V.; McKelvey, T. E. 74-WA/HT-9. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The development and application of an analytical tool for predicting the natural and forced convection flows within the thermal barrier are described. The differential equations governing the flow and heat transfer within the thermal barrier were developed. Two basic assumptions in formulating these equations are (1) that the flow obeys Darcy's law (the gas velocity is proportional to the pressure gradient) and (2) that, locally, the gas temperature equals the solid temperature. Since the resulting differential equations are elliptic, a numerical solution for two-dimensional viscous flows was modified and used. To verify the application of the numerical solution, calculated results for an enclosed, vertical insulation layer are compared with experimental results. Boundary conditions include an imposed temperature difference, yielding a natural convection flow, and an imposed pressure gradient, producing a forced convection permeation flow. Numerical results are also presented for the HTGR thermal barrier located in the lower crossduct where the potential for a high temperature permeation flow exists. 7 references. (auth)

31780 THERMAL BEHAVIOR AND DESIGN CONSIDERATIONS OF HTGR FUEL STORAGE WELLS. Del Bene, J. V.; Shah, N. J.; Rao, S. R. 74-WA/HT-10. New York; American Society of Mechanical Engineers (1974). 11p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

An HTGR fuel storage well is a vertically oriented, steel cylindrical pipe 0.45 m (18 in.) in diameter and 18.9 m (62 ft) long. The wells are imbedded in a large concrete monolith, and cooling coils welded to the steel pipe provide for the removal of fuel element decay heat. The thermal aspects of the design criteria, which include the temperature limits on the fuel elements, the steel liner, the concrete monolith and the working floor of the storage well facility are discussed. The effect of the thermal behavior of the fuel storage well on its design is also discussed. Aspects of the thermal behavior include the make-up of the thermal resistance between the fuel elements and the cooling water sink, the characteristics of the fuel element afterheat generation, the nuclear energy escape in the form of γ-radiation, and the thermal response characteristics of the fuel elements and the massive concrete monolith. (auth)

31781 EXPERIMENTAL RESULTS FOR DECAY OF HOT STREAKS IN A HIGH TEMPERATURE GAS COOLED REACTOR. Chin, E.; Keller, H. C. 74-WA/HT-5. New York; American Society of Mechanical Engineers (1974). 13p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Thermal decay of hot streaks in the primary coolant of a high temperature gas cooled reactor (HTGR) has been experimentally measured. Heated air was injected into an ambient air flow through a model of one of the primary coolant loops. Temperature and velocity profiles were measured at several locations for test parameters of Reynolds number, heated region to nominal unheated flow rate ratio, and location of hot streak injection. A superposition method for predicting hot streak decay for multiple heated jets was applied. (auth)

31782 CONDITIONS LEADING TO FLOW REVERSAL IN A DOWNFLOW CORE. Lawn, C. J.; Withrington, D. 74-WA/HT-63. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The integral block design of High Temperature Reactor is cooled by helium flowing downwards through a large number of small coolant channels. Under conditions of low flow, during load following or after a reactor trip, there is a possibility that buoyancy forces will cause the gas to reverse direction in some channels of the core. This is undesirable as it could lead to high thermal stresses within the blocks and overheating of above-core components. Numerical calculations have been made of the behavior of one block column in which some of the coolant channels differ from the remainder, either in having high resistance coefficients or in being associated with higher than average power generation. As the pressure difference applied across the column is reduced, these channels tend to reverse earlier than the others, although restrained by conduction damping and by the thermal capacity of the block. The uncertainties in the calculation associated with the imprecision in friction factor and Stanton number data for strongly buoyancy-influenced flows are identified; and the effects of varying the gas inlet temperature and the thermal conductivity between channels are examined. (auth)

31783 HEAT TRANSFER ON COILED TUBULAR MATRIX. Abadzic, E. E. 74-WA/HT-64. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Coiled tubular matrices in steam generators of modern gas-cooled power reactors are very similar to the cryogenic tubular exchangers already built for many decades. Several published heat transfer measurements from both engineering areas are discussed. A comparison of the correlations derived from the investigations on several coils together with our own measurement indicate a good agreement in a wide Reynolds range. The compared coils have had different tube diameters from 7 to 25 mm and different transversal and longitudinal pitches. For comparison the Hausen-Glaser approach for definition of a characteristic fluid velocity was used. The resulting general heat transfer equations for the coiled tubular matrix cover a range between $Re = 10^3$ to $Re = 10^6$. 10 references. (auth)

31784 COSTANZA DRAGON: A DYNAMICS CODE FOR THE ANALYSIS OF THERMAL TRANSIENTS OF AN HTGR CORE. Vincenti, E.; Mancini, G.; Clusaz, A.; Woloch, F. 74-WA/HT-65. New York; American Society of Mechanical Engineers (1974). 16p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A thermohydraulics-neutronics code COSTANZA has been developed for the transient analysis of the high temperature reactor cores; its main characteristics are the use of two energy groups and of two geometrical dimensions (RZ). The development of the model has been carried out in order to enable the user to study the temperature transient in two different HTGR fuel concepts: the pin and block fuel type (i.e., the tubular interacting fuel pin design) and the integral block fuel type. For this last design account had to be made of the two-dimensional temperature distribution in the fuel element. The code tries as far as possible to describe in detail a characteristic HTGR core: for each of the five radial regions in which the core can be subdivided, a variable number of channel types can be considered they can differ from each other because of the power, the irradiation time, and the gagging. A maximum of 20 different types in the whole core is allowed. Redistribution of mass flow among the core channel population is accounted for. Fast neutronic transients (i. e., control rod ejection) as well as lower thermohydraulic perturbations (i.e., partial loss of core cooling) can be dealt with by the program. (auth)

31785 POSSIBILITIES OFFERED BY NUCLEAR ENERGY IN THE VARIOUS BRANCHES OF STEEL PRODUCTION. Astier, J. (Institut de Recherches de la Siderurgie Francaise (IRSID), 78-Saint-Germain-en-Laye). Rev. Met. (Paris); 71: No. 7, 587-603(Jul 1974). (In French).

The different branches of steel production and their energy consumptions are reviewed. The application of nuclear energy, in the form of electricity or even as thermal energy obtained from a high-temperature nuclear reactor is discussed in relation to the two basic steel works activities: oxygen blast-furnaces and electric prereduction. (FR)

31786 HIGH-TEMPERATURE REACTORS: THEIR CHARACTERISTICS, DEVELOPMENT AND PROSPECTS FOR IRON METALLURGY. Pecqueur, M. (CEA, 75-Paris (France)); Rastoin, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Rev. Met. (Paris); 71: No. 7, 565-580(Jul 1974). (In French).

The main characteristics of the HTR type reactors (association of a refractory nuclear fuel and a chemically inert cooling gas contained in a prestressed concrete vessel) are presented. Their development is exposed: Dragon reactor (1965), A. V. R. and Peach-Bottom reactors (1967), Fort-Saint-Vrain and Schmehausen reactors (1974-1977), G. A. type reactors (1979-1980). The applications of these reactors to iron metallurgy are discussed: integrated nuclear-iron works complexes or centralized gas-electricity plants. (FR)

31787 USE OF GAS TURBINES IN NUCLEAR STATIONS. Chaboseau, J. (Compagnie Electro-Mecanique (CEM), 75-Paris (France)). Rev. Gen. Therm.; 13: No. 155, 837-845(Nov 1974). (In French).

The direct and closed thermodynamic gas cycles usable in nuclear power stations equipped with helium-cooled HTR reactors are defined. The various factors acting on the thermodynamic efficiency are studied: high temperature, recuperator efficiency, pressure loss in the loop, compression ratio, and expansion. The high temperature value for the cold end of the cycle is shown to provide advantages in heat production (town heating). (FR)

31788 A NUCLEAR, INTEGRATED GAS TURBINE PLANT FOR 1,000 MW. Eiermann, A. BBC-Nachr.; 56: No. 11, 473-480 (1974. (In German).

5 figs.; 1 tab.; 4 refs.

Studies concerning the construction of a nuclear high-temperature helium turbine plant have reached an advanced stage. The author introduces the concept of such a plant and discusses the latest state of development. The developments and investigations still necessary are described. (auth)

31789 A FUEL-ELEMENT FOR GAS-COOLED NUCLEAR REACTORS, AND NUCLEAR REACTORS COMPRISING SAME. Hosegood, S. B. (to Commission of the European Communities, Luxembourg). French Patent 2,188,244/A/. 8 Jun 1973. 15p. (In French).

The fuel element is characterized by an external annular region containing fertile material and an internal annular region forming a channel for the coolant. The interior surface of the internal region can have a thin coating of graphite. The elements are grouped units in graphite blocks; the core of the reactor has a certain number of these units. Such a fuel element is particularly convenient for a reactor of the thermal neutron type cooled by helium. (tr-auth)

31790 FUEL ELEMENT FOR NUCLEAR REACTOR. Bujas, R.; Ringot, C. (to CEA, 75 - Paris (France)). French Patent 2,194,020/E/. 26 Jul 1972. 4p. (In French).

According to the invention, the cloth of carbon or graphite wrapped around the combustible portion of the fuel-element and contingently the combustible portion itself is impregnated with pitch, possibly mixed with graphite powder, subsequently submitted to a thermal treatment and contingently to a de-gassing operation. This can be applied to nuclear reactors in particular of the high-temperature type. (FR)

31791 A METHOD FOR DETERMINING THE BROKEN-PARTICLE RATIO IN THE COMPACTS OF HIGH-TEMPERATURE NUCLEAR REACTORS. Chenebault, P.; Pointud, M. L. (to CEA, 75 - Paris (France)). French Patent 2,188,250/A/. 7 Jun 1972. 6p. (In French).

This invention relates to a rapid and non-destructive method for determining the ratio of broken particles in the compacts of high-temperature nuclear reactors (H.T.R.), both prior to, during and after irradiation. The method comprises the steps of placing in a neutron flux the compacts to be tested together with reference compacts containing a known number of fissile material kernels with no tight coating, driving the fission gases evolving from the broken particles and from the non coated kernels by means of a flow of inert gas or in vacuo, trapping these gases, determining same by comparing the results concerning the reference compacts with those concerning the compacts to be tested, which provides the requested ratio of broken particles. (FR)

31792 A METHOD AND DEVICE FOR CONTROLLING THE POSITION OF THE BOTTOM PORTIONS OF THE BLIND HOLES OF A MEMBER, E.G. A GRAPHITE BLOCK. Boutaine, J. L.; Bujas, R.; Tortel, J. (to CEA, 75 - Paris (France)). French Patent 2,187,111/D/. 31 May 1972. 9p. (In French).

This description relates to a method for controlling the position of the bottom portions of the blind holes of a member, the method comprising: emitting a thin parallel beam of X or gamma photons along the axis of each hole towards the bottom portion thereof, then observing the intersections of the various X or gamma beams with an appropriate device, the device being mounted outside of the member in register with the blind holes and having an accurately adjusted position with respect to that member. The method can be applied to the graphite blocks of high temperature reactors. (FR)

31793 ARMATURE FOR REACTOR CIRCUITS, ESPECIALLY FOR HIGH-TEMPERATURE REACTORS WITH A PASSAGE FOR SPHERICAL FUEL ELEMENTS. Kaiser, R.; Pohlig, N.; Beser, A.; Scholz, W. (to Argus Gesellschaft m.b.H., Ettlingen (F. R. Germany)). German(FRG) Patent 2,130,220/B/. 4 Jan 1973. 3p. (In German).

An invention is described whose object is to provide a well-sealable armature for a free passage of spheres, where the sealed sections present in the armature are to be subjected to least possible wear through the movement of the spheres, and where the release of radioactive gases due to large temperature differences is also to be avoided. The passage can be closed by turning a closing sphere arranged in its wall around a perpendicular axis in a longitudinal direction to it. The closing sphere is in a floating position. Between the passage wall and the closing sphere, there are polyimid seals whose contact pressure is adjustable. (GE)

31794 THE HIGH-TEMPERATURE REACTOR. Its Characteristics, Its Significance for the Future, Operating Experience to Date. Bedenig, D. (General Atomic Europe, Zurich (Switzerland)). VGB Kraftwerkstechnik; 54: No. 12, 782-787(Dec 1974). (In German).

The overall plant is described using a 1,160 MW(e) nuclear power station as an example. The following characteristic features are discussed: use of ceramic fuel in the form of coated particles; graphite as the moderator and structural material; helium as coolant. The design of the nuclear steam supply system and also the secondary section of a large high-temperature gas-cooled reactor plant (HTGR) are described. Operating experience with the Peach Bottom and AVR experimental reactors and the status of the 330 MW(e) Fort St. Vrain nuclear power station are reported. The future prospects of direct cycle HTGR's, applications of HTGRs for nuclear process heat production, and also the gas-cooled fast breeder are briefly discussed. (auth)

31795 HTR WITH BLOCK-TYPE FUEL TO ACHIEVE HIGH COOLING GAS TEMPERATURES. Brandes, S.; Ehlers, K. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F.R. Germany)); Kraemer, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)); Simon, W. (Gulf General Atomic Co., San Diego, Calif. (USA)). Atomwirt., Atomtech.; 19: No. 12, 589-592 (Dec 1974). (In German).

Although nowadays main efforts are done to introduce the HTR two-cycle plant, developments were started in USA as well as in the Federal Republic of Germany to use the possible high cooling gas temperatures of the high-temperature reactor for direct-cycle plants with gas turbine and for process heat production. Due to present technologies and with a suitable layout of reactor and fuel elements, gas outlet temperatures of 850°C for direct-cycle plants and cooling gas outlet temperatures of 950°C for process heat reactors can be realized with block-type fuel elements. Here, the allowed max. fuel temperature of 1,350°C will not be exceeded and the rate of fission product release tolerable for the corresponding purpose is kept. The requirements of a direct-cycle and a process heat plant can be fulfilled in principle by the same fuel element. This fuel element corresponds in its overall dimensions and number of cooling and fuel channels to the one of the American Fort St. Vrain reactor. (auth)

31796 THE BEHAVIOR OF METHYL IODIDE IN THE WIND-SCALE AGR. Hillary, J. J.; Taylor, J. C. (UKAEA Reactor Group, Sellafield). pp 79-98 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Three experiments have been carried out in which labelled methyl iodide sources were injected into the WAGR pressure circuit under different reactor temperature conditions and the rate of removal of iodine from the gas was followed by a sampling programme. At low temperatures the removal rate corresponds to a half-life of 30 minutes, but at more elevated temperatures the half-life is 30 seconds or less initially, increasing rapidly to produce eventually a steady iodine concentration in the gas. (FR)

31797 LONG TERM CONTAINMENT OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE SOLID WASTES AT NUCLEAR POWER STATIONS OF THE CENTRAL ELECTRICITY GENERATING BOARD. Myatt, A. R. (Central Electricity Generating Board, London (UK)). pp 703-720 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

In the United Kingdom, the Central Electricity Generating Board has eight Magnox type power stations operating and four AGR stations under construction. Radioactive solid wastes except for irradiated fuel elements are required to be accumulated in a suitable manner on each nuclear site. The controls and inspection exercised by Government Departments to ensure compliance with legislation are outlined. A description is given of the satisfactory techniques developed over several years for handling and packaging the various categories of waste. Information is provided on the quantities of wastes of different types and activities, which arise from operating gas-cooled reactors. The design and provision of appropriate and adequate storage facilities is discussed. A typical program of health physics monitoring and record keeping is included which confirms the adequacy of containment. Operational experience has enabled changes to be made in waste storage designs of future stations. The main features of these developments are described and reference is made to a number of specific problems which have been overcome. The question of ultimate disposal is briefly discussed and some changes in philosophy now being introduced at reactor sites are related. (FR)

31798 A NUCLEAR REACTOR CORE COMPRISING MODERATOR PRISM-SHAPED BLOCKS, AND A NUCLEAR REACTOR PROVIDED WITH SAID CORE. Hosegood, S. B.; Lockett, G. E. (to Commission of the European Communities, Luxembourg). French Patent 2,189,815/A/. 19 Jun 1973. 9p. (In French).

31799 COATED NUCLEAR FUEL PARTICLES. Piccinini, N. (Politecnico, Turin). Advan. Nucl. Sci. Technol.; 8: 255-341 (1975).

Information on coated fuel particles for HTGR reactors is presented concerning the fabrication, properties, and performance of pyrolytic carbon coated UO_2 particles; pyrolysis, deposition, and properties of pyrolytic carbon and silicon carbide; mathematical model analysis for coated fuel particles; production equipment; coating characteristics according to the deposition conditions; analysis and control of the finished particles; and irradiation tests. 299 references. (DCC)

31800 DEVELOPMENT PROGRAM FOR THE FORT ST. VRAIN THERMAL BARRIER. Jones, G.; Brislin, R. T. 74-WA/HT-1. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The development program in order to design, fabricate, and install a thermal barrier on the inner surface of the prestressed concrete reactor vessel (PCRV) of the Fort St. Vrain High-Temperature Gas-Cooled Reactor (HTGR) is described. This thermal barrier is required to function in a helium environment at pressures of 5.0 MPa and temperatures up to 1090°C. A summary of the requirements to be met in insulating the internal surfaces of PCRVs for HTGR applications and the many differences between these applications and more conventional uses of fibrous insulating materials are presented. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 32212.

31801 (AED-CONF-74-571-012) RECYCLE OF PLUTONIUM IN UK THERMAL REACTORS. Green, A.; Dodds, R.; Syrett, J. 1974. 4p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

Issues involved in plutonium recycle in thermal reactors, taking the steam generating heavy water reactor (SGHWR) as an example are outlined, and the time needed to design and construct the fuel production facilities is discussed. The economics of plutonium recycling in the SGHWR together with its effect on uranium requirements and on future fast reactor capacity are briefly investigated. (GE)

31802 (AED-CONF-74-571-021) HEAVY WATER CRITICAL EXPERIMENTS ON PLUTONIUM UTILIZATION IN ADVANCED THERMAL REACTOR "FUGEN". Miyawaki, Y.; Kato, H. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). Oct 1974. 28p. (N-941-74-72). INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

With figs. and tabs.; 11 refs. Available from ZAED.

A description of the reactor is given by main design data and core configuration (PuO_2-UO_2, UO_2 fuels). The void reactivity is decreased by Pu and the local peaking factor is reduced by two different local fissile Pu concentrations. Experimental results and analyses are presented with emphasis on the void reactivity, neutron flux distribution, and power distribution in the partially mixed oxide fuel core. (GE)

31803 (CRNL-1240) A CANDU-BLW REACTOR DESIGNED FOR PLUTONIUM RECYCLE. Slater, J. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1974. 7p. (AED-CONF-74-571-025). INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

2 figs.; 2 tabs.; 7 refs. With abstract. Available from ZAED.

The details of the design and of the fuel cycle of a heavy-water moderated BWR are described which as fuel contains uranium oxide from natural isotope composition enriched with Pu. Furthermore, the influence of a U-235 enrichment of the fuel on the economy is examined. (GE)

31804 $1.25 BILLION TWINS: PICKERING GENERATION. Mod. Power Eng.; 68: No. 12, 50-51(Dec 1974).

Now that the problem of pressure tube leaks in Unit 3 of Ontario Hydro's highly successful Pickering Generating Station has been resolved, construction of a twin station, Pickering B, is underway. The first unit of Pickering B is scheduled for completion in 1980, and the other units are to be complete before the end of 1982. The addition of a second station will bring total nuclear capacity at Pickering to 4,320 MW. (CA)

31805 SHIELDING REACTORS. Chem. Can.; 26: No. 9, 12(Oct 1974).

The technique of using steel shot balls in water for reactor shielding was first used in Ontario Hydro's Bruce-2 generating station. The steel balls, in sizes of one-inch and three-eighths inch diameter, are convenient to transport, and permit a homogeneous mixture of steel/water for efficient shielding. In all, 611 tons of the steel balls were used in Bruce-2. (CA)

31806 SIMULATION OF BRUCE PHW NUCLEAR GENERATING STATION FOR CONTROL STUDIES. Stebbing, J. D. (Atomic Energy of Canada Ltd., Sheridan Park Ont.); Luxat, J. C. pp 436-441 of Proceedings of the 1973 Summer Computer Simulation Conference, La Jolla, California. La Jolla, CA; Simulation Councils Inc. (1973).

From proceedings of the 1973 summer computer simulation conference; La Jolla, CA (1973).

A simulation study of the Bruce PHW Nuclear Generating Station is outlined. The purpose of the simulation is to assist in the design of control and safety systems for the station and to aid the debugging and precommissioning testing of computer control programs. The simulation was implemented entirely as a digital simulation on a mini-computer-based computing facility. The philosophy underlying the choice of an all-digital implementation is presented, and the extremely flexible, and highly interactive nature of the resulting simulation package is stressed. (auth)

31807 CERAMOGRAPHIC AND METALLOGRAPHIC EXAMINATION OF PINS OF THE FUEL ELEMENT ATUCHA BE 1 (CNEA-MZFR PROTOTYPE 1). Romer, O. pp 127-139 of Reports from the Hot Cells. Karlsruhe, F. R. Germany; GfK (1974). (In German).

5 figs. Available from the Gesellschaft fuer Kernforschung.

Following the irradiation of the prototype fuel element Atucha BE 1 in the upper half of the MZFR on 247 full load days, post-irradiation investigations were carried out for which fuel rods having the highest burnup values were chosen. Cross sections through the upper end of a fuel rod, through its middle, and through the lower rod end were ceramographically examined. The radiochemically determined burnup values of these cross-section regions are about 0.3 At. %, 0.6 At. % and 0.9 At. %. For the metallographic investigations, the welding seams with the boundary part of the cladding tubes were of importance. For this, longitudinal cuts were taken. For every ceramographic section, an α- and β-γ-autoradiography picture was made, as a matter of routine, in order to be able to follow the rise and distribution of the activities. The ceramographic pictures showed a transition of inhomogeneous (original sintered microstructure) to homogeneous structure as a result of rod power and temperature during the irradiation. The UO_2 fuel pellets had numerous cracks. The fuel lay loosely on the cladding tube. No release of fission product in the fuel could be detected. No reaction could be confirmed between the fuel and the cladding. The exterior side of the cladding tube was partly corroded. The metallographic investigations showed no irradiation-effected changes of the cladding tube material (Zircaloy-2). (GE)

31808 MEASUREMENTS OF TEMPERATURE FLUCTUATIONS IN A GAS-COOLED POWER REACTOR. Greef, C. P. (Central Electricity Generating Board, Berkeley, Eng.). Ann. Nucl. Sci. Eng.; 1: No. 9/10, 481-493(Sep 1974).

The results obtained from measurements of thermocouple noise signals from a graphite moderated gas cooled reactor are presented. An overall survey demonstrated that in the frequency range covered (up to 0.15 Hz), the reactor behaved as a closely coupled system with no significant phase differences between different parts of the core. Furthermore, the temperature noise power spectra could be divided into two distinct frequency regions in this range. In the lower part of the range the observed fluctuations were found to be due to overall reactor power fluctuations, and in the upper part to heat transfer coefficient variations. A simple model of the noise processes in the reactor was developed and verified by consideration of the transfer function between coolant and fuel temperatures. (auth)

Power Reactors, Breeding

Refer also to abstracts 29524, 29757, 29759, 30152, 30153, 30363, 31766, 32182, 32183, 32189, 32190, 32197, 32208, 32209, 32211, 32213, 32225, 32226, 32228, 32298, 32299, 32307, 32312, 32313, and 32320-32322.

31809 (ANL-RDP-35) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, DECEMBER 1974. (Argonne National Lab., Ill. (USA)). 31 Jan 1975. Contract W-31-109-eng-38. 213p. AT.

Progress is reported in the following areas: (1) EBR-2 operations and testing; (2) LMFBR design support; (3) instrumentation and control; (4) fuels and materials development; (5) reactor physics; (6) reactor safety; (7) and GCFR studies. (JWR)

31810 (ANL-RDP-36) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JANUARY 1975. (Argonne National Lab., Ill. (USA)). 27 Feb 1975. Contract W-31-109-eng-38. 160p. AT.

Progress is reported in the following areas: EBR-2 operation and testing; Hot Fuel Examination Facility; LMFBR design support; instrumentation and control; fuels and materials development; fast reactor physics; reactor safety analysis and experiments; and GCFR studies. (DCC)

31811 (CONF-750303-29) DECAY HEAT ANALYSIS FOR AN LMFBR FUEL ASSEMBLY USING ENDF/IV DATA. Morrison, G. W.; Weisbin, C. R.; Kee, C. W. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Recently evaluated ENDF/B-IV fission product data have been used in decay heat calculations for typical LMFBR fuel assemblies exposed to 100,000 MWd/MT burnup. The decay heat and radioactivity of the fuel assemblies have been calculated as a function of time from discharge. Important contributors to the decay have been identified. 21 references. (auth)

31812 (GEAP-12538) THERMOMIGRATION AND REACTIONS OF FISSION PRODUCTS IN BREEDER REACTOR OXIDE FUELS. II. Out-of-pile Investigation of Cs- and Te-Induced Attack of Type-316 Stainless Steel Cladding. Aitken, E. A.; Adamson, M. G.; Dutina, D.; Evans, S. K. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Sep 1974. Contract AT(04-3)-893. 18p. AT.

The results of isothermal capsule tests containing mixtures of cesium and tellurium with various oxygen buffers and heated between 450 and 1000°C for 100 and 1000 hours show intergranular attack of Type-316 stainless steel occurs when the Cs : Te ≤ 2 and the oxygen potential of the buffer exceeds the oxidation threshold for stainless steel. Carbon increases the tendency for intergranular penetration if the oxygen potential is slightly above the oxidation threshold ($\Delta\bar{G}_{O_2}^{725°C} = -134$ kcal mol^{-1}). At high oxygen potentials ($\Delta\bar{G}_{O_2}^{725°C} \cong -100$ kcal mol^{-1}) carbon has no effect on enhancing the attack. Activation energies for carbon-assisted and noncarbon-assisted attack were 21.5 and 17.5 kcal mol^{-1}, respectively. To cause attack by cesium alone, or cesium with molybdenum oxide, an oxygen potential greater then −84 kcal mol^{-1} was necessary. Reaction experiments show the compound $Cs_{1.3}(U,Pu)O_3$ is more stable than Cs_2UO_4 and Cs_2MoO_4. However, Cs_2MoO_4 may be stable in irradiated fuel rods because of its ability to volatilize and deposit on the inside cladding surface. (11 references) (auth)

31813 (GEAP-14015) INSTRUMENTED SIMULATED FUEL ASSEMBLY DESIGN AND DEVELOPMENT. Grantz, A. L. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1974. Contract AT(04-3)-893. 56p. AT.

Two simulated fuel assemblies with load measurement capabilities have been designed, developed and fabricated. The Instrumented Simulated Fuel Assemblies (ISFA's) have been delivered to W-ARD to be used in the 3-D Core Restraint Test Rig for the purpose of measuring inter-fuel-assembly loads under simulated refueling and operating conditions. The design basis of the ISFA's including requirements, component design, component development tests and design (performance) verification tests is presented. (7 references) (auth)

31814 (GEAP-14021) STEADY-STATE AND TRANSIENT FUEL MECHANICS: THE BEHAVE-3 CODE. Oldberg, S. Jr.; Stuart, R. G. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Aug 1974. Contract AT(04-3)-893. 270p. AT.

The BEHAVE-3 computer program is described, along with instructions for its use. The finite element method with cylindrical symmetry is used to predict fuel rod cladding stresses and strains during steady state, transient overpower, and transient under-cooling irradiations. BEHAVE-3 is operational on the Honeywell-6000 computer. It requires 45K of fast memory and uses FORTRAN-IV, GMAP. The method of solution is generally the same as BEHAVE-2 and the grid size is the same as in BEHAVE-2. A transient problem with coupling to THTD heat-transfer calculations, the maximum number of spatial nodes, and 28 timesteps has required 12 minutes of Honeywell-6000 processor time. (19 references) (auth)

31815 (GEAP-14031-1) CORE RESTRAINT ENGINEERING FIRST QUARTERLY REPORT, AUGUST–OCTOBER 1974. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1974. Contract AT(04-3)-893. 12p. AT.

Core restraint system design requirements, subcomponents, and analytical methods in accordance with LMFBR Program Plant Task 6-216-1, 6-216-2, and 6-216-3 are presented. Progress during August, September and October 1974 is described for subtasks related to withdrawal force testing, transient analysis, contact pad and channel wall lateral limits, in core contact pad surveillance, and withdrawal force minimizer. (auth)

31816 (GEAP-20589) REVIEW OF 2-1/4Cr–1Mo STEEL FOR STEAM GENERATOR APPLICATIONS IN THE CLINCH RIVER BREEDER REACTOR. Licina, G. J.; Copeland, J. F. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1974. Contract AT(04-3)-893. 42p. AT.

The justification for the selection of 2-1/4Cr-1Mo ferritic steel as the material for use in the steam generators of the Clinch River Breeder Reactor Project is presented. The reference material exhibits proven fabricability to the requirements of ASME Section III, Class 1 and a virtual immunity to stress corrosion cracking under possible off-chemistry conditions — the primary selection criteria. The material exhibits satisfactory, well-characterized compatibility with sodium and water environments and provides adequate mechanical properties for the 210,000 hour design life. A discussion of the effects of heat treatment with respect to microstructure, mechanical properties, and possible embrittlement tendencies is also given to provide a basis for the selection of the heat treatment for CRBRP components. (76 references) (auth)

31817 (JAPFNR-176) FINAL REPORT ON A DEVELOPMENT STUDY OF THE SHEATHED-THERMOCOUPLE-ELECTRODE FLOWMETER AS A PART OF STUDIES FOR THE FBR INSTRUMENTATION. Kuwabara, J.; Kato, Y.; Furukawa, K.; Kawaguchi, C. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 90p. (PNC-N-251-74-14). Dep. NTIS (US Sales Only) $5.45.

Work performed under United States–Japanese Fast Reactor Exchange Program.

The sheathed-thermocouple-electrode flowmeter consists of a magnet circuit mounted inside the side wall of the subassembly and a pair of grounded-type sheathed chromel-alumel thermocouples inserted into the outlet of the subassembly where the magnetic field traverses. Outlet temperature, channel flow rate, boiling, pin clad rupture, FP gas release and gas entrainment are expected to be detected from the four wires of the thermocouples. Feasibility of this unique proposal has already been proven. A development study of the sheathed-thermocouple-electrode flowmeter, as a part of studies for the FBR instrumentation has been performed for the PNC, during the period May 1970 through March 1971. Skeleton design of a prototype S/A instrumentation was completed. Twenty-one prototype magnet circuits were made without any difficulty, and the performances are satisfactory. The best magnet orientation which avoids magnetic interaction trouble is found in the unidirectional exclusive arrangement. Recent information on performance of magnet in the reactor environment promises that the proto-type magnet can work at least for the scheduled mission time in this proposal. Linearity and temperature effect of this type with external magnet are almost equal to those of the ordinary type. Effect of emf shunt by the sheath is studied in detail. Passing void may be detected more sensitively from the pulsive noise on the flow signal rather than from the level increase of the flow signal. More skillful experimental technique for the void injection should be developed to solve this problem. (auth)

31818 (KFK-1999) CONTRIBUTION TO THE FUEL ELEMENT DEVELOPMENT FOR THE FAST BREEDER REACTOR SNR-300. Boehm, H.; Dienst, W.; Kummerer, K. (Comps.). (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Sep 1974. 345p. (In German). Dep. NTIS (US Sales Only) $20.25.

Nineteen papers are presented which deal with the design, fabrication, and testing of SNR fuel elements. Each paper has been separately abstracted and indexed for NSA. (DG)

For abstracts of individual papers see: 31819–31837.

31819 (KFK-1999, pp 1-25) REQUIREMENTS AND OPERATING LIMITS FOR SNR FUEL ELEMENTS. Kummerer, K. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

A description of the SNR includes core specifications and fuel element concepts and design criteria. A compilation of fuel element specifications is presented for all currently operating or planned sodium cooled fast reactors. (DG)

31820 (KFK-1999, pp 27-42) FUEL CONFIGURATION CONSIDERATIONS AND PROBLEMS. Dienst, W. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Fuel element design is considered with respect to processes leading to fuel-cladding interactions and fuel melting. Processes are identified for which additional data on fuel performance are needed. (DG)

31821 (KFK-1999, pp 43-58) EFFECT OF BURNUP-DEPENDENT PHENOMENA ON CENTRAL TEMPERATURE. Ondracek, G.; Schulz, B. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

The central temperature of a mixed oxide LMFBR fuel element is strongly dependent on the end-of-life plutonium content and the O/M ratio. Fuel melting is more likely to occur during initial irradiation than at high burnup. The mean porosity is adequate with regard to thermal conduction. Fission products have a negligible effect on thermal conductivity at high power density. (DG)

31822 (KFK-1999, pp 59-80) FUEL-CLADDING STRESSES. Brucklacher, D.; Dienst, W.; Zimmermann, H. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

A discussion of fuel-cladding interactions includes fission gas production, fuel swelling due to fission products, irradiation-induced fuel densification, and thermal ratcheting. (DG)

31823 (KFK-1999, pp 81-110) FUEL-CLADDING INTERACTIONS. Goetzmann, O.; Hofmann, P.; Kleykamp, H. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Chemical interactions between LMFBR fuel cans and fuel material and fission products are examined. Results of post-irradiation analyses of mixed oxide fuel elements are described, and fuel can corrosion considerations for the SNR are discussed. (DG)

31824 (KFK-1999, pp 111-117) CONCLUSIONS FOR FUEL AND FUEL ELEMENT CONFIGURATION. Dienst, W. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Conclusions are drawn on the basis of LMFBR fuel performance studies, and recommendations for further studies are made. (DG)

31825 (KFK-1999, pp 119-148) PHYSICAL RADIATION EFFECTS ON FUEL CAN MATERIALS. Closs, K. D.; Schaefer, L.; Schirra, M.; Wassilew, C. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Data are reported on the dependence of mechanical properties of steels D1N-1-4970, -4981, -4988 on fast neutron fluence. (DG)

31826 (KFK-1999, pp 149-172) IRRADIATION INDUCED CREEP AND SWELLING OF FUEL CAN MATERIALS. Ehrlich, K.; Herschbach, K.; Schneider, W. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Results are presented from irradiation studies of steels D1N-1-4988 and -4990 conducted at the Dounreay Fast Reactor, the Rapsodie reactor, the BR-2 reactor, and the Harwell Variable Energy Cyclotron. (DG)

31827 (KFK-1999, pp 173-189) CORROSION RESISTANCE OF FUEL CAN MATERIALS. Borgstedt, H. U. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Chemical effects of sodium on steels D1N-1-1.4970, -1.4981, and -1.4988 are examined. Included are discussions and data on (1) temperature and acidity dependence of the rate of metal loss through sodium corrosion, (2) erosion morphology, (3) formation of layers with ferritic structure, (4) structural stability, (5) long-term effects, (6) in-pile effects, (7) boron, nitrogen, and carbon concentration changes, and (8) effects on mechanical properties. (DG)

31828 (KFK-1999, pp 191-201) COMPREHENSIVE APPRAISAL OF SNR FUEL ELEMENTS IN VIEW OF NEW FUEL CAN MATERIALS. Boehm, H. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Criteria for selection of fuel can materials are listed, and steel D1N-1-1.4970 is identified as the best available material. (DG)

31829 (KFK-1999, pp 203-219) THEORETICAL MODELING OF FUEL ELEMENT PERFORMANCE. Elbel, H. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Calculated results are presented for SNR oxide fuel elements. Included are data on fuel element temperature distribution, rearrangement of fuel material, fuel-cladding contact, fuel can stresses, fuel can swelling, and overall fuel element performance. (DG)

31830 (KFK-1999, pp 221-231) THEORETICAL DESCRIPTION OF FUEL ELEMENT PERFORMANCE USING THE SATURN-3 CODE. Keller, K. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

A description is provided of the SATURN-3 code written to predict the performance of SNR oxide fuel elements. (DG)

31831 (KFK-1999, pp 233-242) FUEL ELEMENT SPECIFICATIONS AND THEIR EVALUATION. Freund, D. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

The interrelationship among fuel element specifications, fuel irradiation testing, and post-irradiation analysis is examined for the purpose of developing a systematic approach to the problem of SNR fuel element design. (DG)

31832 (KFK-1999, pp 243-249) FABRICATION OF OXIDE FUEL SPECIMENS FOR THE IRRADIATION PROGRAM OF THE FAST BREEDER PROJECT. Wedemeyer, H. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

SNR fuel material production is considered with regard to requirements imposed by fuel specifications. The processes involved in fabrication of sample fuel elements are illustrated. (DG)

31833 (KFK-1999, pp 251-270) FUEL, FUEL CAN, AND FUEL ELEMENT QUALITY CONTROL. Vollath, D.; Jacobi, O. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Fuel material quality control includes determination of O/M ratio, plutonium distribution, and plutonium particle size. Fuel cans must meet requirements pertaining to geometry, mechanical and chemical properties, and fabrication processes. The completed fuel element is subjected to additional tests and measurements. (DG)

31834 (KFK-1999, pp 271-282) ESSENTIAL EXPERIMENTS INVOLVING FUEL ELEMENTS AND FUEL ASSEMBLIES. Freund, D. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

A description is given of fuel element and fuel bundle irradiation studies of SNR oxide and carbide fuels. (DG)

31835 (KFK-1999, pp 283-306) IRRADIATION FACILITIES. Borjarsky, E.; Deckers, H.; Haefner, H.; Lehning, H.; Reiser, H.; Schmidt, L. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

A description is given of facilities used in the development and testing of SNR fuel elements. Included are irradiation capsules used at the BR-2 reactor for fuel can and structural material studies and irradiation capsules used at the FR-2 reactor for fuel material and fuel element studies. The helium loop in the FR-2 reactor is also described. (DG)

31836 (KFK-1999, pp 307-325) NONDESTRUCTIVE TESTING. Geithoff, D. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Nondestructive examination techniques employed in the post-irradiation testing of SNR fuel elements are described. Included are visual inspection and photographic documentation, measurements of external dimensions, x-ray images, and gamma scanning. (DG)

31837 (KFK-1999, pp 327-345) CONTRIBUTION OF THE INSTITUT FUER MATERIAL- UND FESTKOERPERFORSCHUNG TO BREEDER REACTOR FUEL ELEMENT DEVELOPMENT. Thuemmler, F. Sep 1974. (In German).

In contribution to the fuel element development for the fast breeder reactor SNR-300.

Activities and accomplishments are listed under the headings of fuel materials, fuel can materials, fuel elements, and planning. (DG)

31838 (LA-5868-MS) PINTEMP: A COMPUTER PROGRAM FOR FUEL ELEMENT DESIGN CALCULATIONS. Kerrisk, J. F. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1975. Contract W-7405-eng-36. 26p. Dep. NTIS $4.00.

The computer program PINTEMP has been written to perform design calculations for fuel elements in the EBR-II reactor. The program calculates fuel element and sodium coolant temperatures, thermal stresses in the clad, and fission gas generated in the fuel during steady state irradiation. (19 references) (auth)

31839 OPTIMUM FAST REACTOR DESIGNS. Wyatt, P. W. Pittsburgh; Carnegie-Mellon Univ. (1974). 463p. University Microfilms Order No. 74-26,655.

Thesis (Ph. D.).

Three types of fast breeder reactors—each of which represents a potential improvement on the current liquid-metal-cooled fast breeder reactor (LMFBR)—are compared on the basis of specific total power generation costs. To eliminate the vagaries inherent in the uniqueness of a given design, an optimization technique is applied to minimize the specific power costs. Each "free" independent variable—that is, a quantity representing a design choice not dictated by considerations of safety, reliability, or some other "common-sense" criterion—is chosen, subject to certain constraints, in order that the specific cost shall be a minimum. The procedure used is Powell's conjugate direction method, and the three reactor types are: (1) a version of the sodium-cooled fast breeder reactor, (2) the indirect-cycle helium-cooled fast breeder, and (3) a metal-clad direct-cycle reactor also using helium as the coolant. Within each of the three gross classifications, several clad-fuel combinations are compared, under the assumption that the same burnup can be achieved in all cases. The costs associated with both the primary and secondary plants are considered. The reactor, the heat exchangers, and—in the case of the sodium-cooled reactors—the vessel are designed in detail and their costs estimated item by item. The pump, compressor, and turbogenerator costs are computed from correlations based only on required power input or power delivered. The remainder of the plant capital is treated as a constant cost. The core physics description is based on a two-zone eight-group diffusion model. The thermal-hydraulics design is dependent on the analysis of an unorificed hot channel. Each heat exchanger is designed to attain a required effectiveness and to meet specifications on the primary membrane stress in the tubes, shell, headers, and tube sheets. The thermal efficiency of each cycle is computed, taking into account pressure drops in the various system components. It is shown that the least competitive of the designs, from an economic standpoint, is the direct-cycle type. This is due largely to an inability to achieve adequate thermal efficiency while using a metal clad. In the indirect-cycle gas-cooled design, the carbide fuel yields little economic advantage over the oxide fuel, because of the low allowable carbide fuel centerline temperature. But, in the case of the LMFBR—which is cooled by sodium, carbide fuel produces a distinct economic benefit relative to oxide fuel. For an oxide-fueled LMFBR, no cladding examined produced any economic advantage over stainless steel. If carbide fuel is used, an inconel or a hastelloy appears to be the best choice of cladding. In no breeder—GCFR or LMFBR—do the refractories (tungsten, molybdenum, niobium) appear to offer any economic benefit: higher allowable coolant temperatures are always offset by reduced breeding and increased materials cost. The final choice, however, between LMFBR and GCFR cannot be made as yet: Tentatively, there appears to be no significant economic difference between the two. (Diss. Abstr. Int., B)

31840 SPHERICAL COATED PARTICLES FOR NUCLEAR REACTORS. (to Societe Belge pour l'Industrie Nucleaire). Netherlands Patent 7,202,304. 22 Feb 1972. 5p. (In Dutch).

The invention provides spherical coated particles for nuclear reactors and in particular for gas-cooled fast reactors. The inner part of the sphere consists of fuel and is surrounded by coating layers. Fuel and coating materials are compatible with each other. (NL)

31841 INVESTIGATIONS ON THE FLOW AND TEMPERATURE DISTRIBUTION DOWNSTREAM OF LOCAL COOLANT BLOCKAGES IN ROD BUNDLE SUBASSEMBLIES. Kirsch, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Nucl. Eng. Des.; 31: No. 2, 266-279(1974).

Experimental and theoretical investigations are reported on the flow and temperature distribution in local recirculating flows in rod bundles downstream from a blockage. A mean coolant temperature in this recirculation zone can be calculated from the dimension of the recirculation zone and the mass exchange rate with the main flow. Similarity analysis for recirculating flow in a simple geometry without rods shows that with a sufficiently high Reynolds number, similar geometry, and similar heat source distribution, the dimensionless temperature fields in recirculating flows are equal and independent of the Reynolds and Prandtl numbers. This result is also observed to be true for rod bundles, justifying the measuring of temperature distributions in water instead of sodium. Typical results are given. (auth)

31842 PRESSURE VESSEL WALL THICKNESS LIMITS BASED ON THERMAL STRESS RATCHETTING AND CREEP FATIGUE INTERACTION. Minami, H. M.; Veljovich, W. 74-WA/PVP-11. New York; American Society of Mechanical Engineers (1974). 27p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The severe thermal transients to which Liquid Metal Fast Breeder Reactor (LMFBR) piping and pressure vessels are subjected may induce high secondary and peak thermal stresses in the pressure boundaries. Since these stresses increase in a nonlinear fashion with wall thickness, the question arises as to the existence of an absolute thickness limit beyond which typical LMFBR plant transients induce stresses and strains which exceed the ASME Boiler and Pressure Vessel Code life and strain limits. To answer this question inelastic analyses of infinite cylinders of various diameter and wall thickness configurations subjected to cyclic thermal transients and high temperature hold times were performed. Since the approximate magnitude and duration of typical current LMFBR normal scram and emergency transients are known, the creep-fatigue damage and incremental strain per cycle were determined, and these results were extrapolated to obtain the allowable number of such cycles which could be sustained without exceeding Code allowable limits. The inelastic analyses were performed using a rigorous, but economical, finite-element computer program based on incremental flow law constitutive equations for creep and plastic strains. The analysis assumed kinematic hardening, as well as currently recommended cyclic strain hardening material behavior. Both primary and secondary creep rates were considered in the analysis. The results of the investigation are presented in the form of design curves for use in conceptual design and feasibility studies. 15 references. (auth)

31843 SOLUTION OF THE AVERAGE, STEADY, ISOTHERMAL FLOW IN ROD BUNDLES USING MATCHED ASYMPTOTIC EXPANSIONS. Lund, K. O. 74-WA/HT-4. New York; American Society of Mechanical Engineers (1974). 17p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The conservation equations of mass, momentum, and energy are derived for the flow of gases in coupled parallel channels, or rod bundles, using the slug-flow approximation in the channels. In the case of gas-cooled rod bundles, the pitch of the rods is relatively large so that the flows in the channels are strongly coupled. From this observation a perturbation parameter, E, is derived and the governing equations are scaled using this parameter, which represents the ratio of the rod diameter to the bundle length. It is of the order of 10^{-3} in current gas-cooled fast breeder reactor designs. By expanding the velocities into perturbation series in E, the isothermal equations for two channels are solved as an initial value problem and the results compared to a finite difference solution of the same problem. Then the N-channel isothermal problem is solved to the first order as a two-point boundary value problem with the pressures specified at the inlet and the outlet. The complete system of equations, including heat addition to the flow channels, is discussed in terms of its asymptotic solution. It is concluded from the study that the method of match asymptotic expansions is applicable to the flow problems of rod bundles; however, further work is required to evaluate possible computational advantages of the method. 12 references. (auth)

31844 EFFECTS OF BOWING DISTORTIONS ON HEAT TRANSFER IN A SEVEN-PIN BUNDLE. Haga, K.; Daigo, Y.; Ohtsubo, A.; Kikuchi, Y. 74-WA/HT-50. New York; American Society of Mechanical Engineers (1974). 11p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The experimental results are presented of heat transfer in sodium flowing in an electrically heated seven-pin bundle where a pin was bowed to form a point contact. Each pin was 6.5 mm in diameter and had a 450 mm heated length. The bundle was tightly packed with 1.3 mm diameter spacer wires and placed in a hexagonal tube. The pitch-to-diameter ratio (P/D) was 1.22. The central pin was bowed symmetrically near the axial mid-plane to form a point contact with an outer normal pin. The measured temperature rise due to the point contact compared fairly well with the calculation by the PICO code. In addition, experiments were carried out with the normal pin bundle to establish a base case and to evaluate the effect of mixing due to spacer wires. When applied the experimental results to reactor conditions, the temperature rise due to a point contact is considered to be less than 30 K. (auth)

31845 DRYOUT IN HELICALLY COILED TUBE OF SODIUM HEATED STEAM GENERATOR. Naitoh, M.; Nakamura, A.; Ogasawara, H. 74-WA/HT-48. New York; American Society of Mechanical Engineers (1974). 16p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The temperature oscillation and its period on the surface of the water tube wall have been measured around the dryout positions by the use of the sodium heated test steam generator. The test tube, which is made of 30-m long, 25.5-m OD 2.25Cr-1Mo steel, is helically coiled with the 1000-mm helix diameter and with the 450-mm axial pitch. Thermal stress and its amplitude applied on the test tube are also estimated from a viewpoint of high cycle thermal fatigue. The results show that (1) the period of the fluctuation of the dryout positions ranges from 3 to 20 sec, that (2) the inside wall peak-to-peak temperature oscillation is under 14.0 C at the water pressure of 171 ata, that (3) the peripheral average DNB quality can be correlated by the simplified equation as function of heat flux and pressure within the scattering range of ± 13 percent of the experimental data, and that (4) the water tube is predicted not to be plastically deformed during 30 yr operation at the water pressure of 171 ata because of smaller actual stress amplitude than the allowable one. 6 references. (auth)

31846 THE DEVELOPMENT OF FAST BREEDER REACTORS AND THE LONG-TERM ENERGY SUPPLY. Hueper, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter); Faude, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Energie; 26: No. 10, 358-364(Oct 1974). (In German).

Not only the earth's fossil fuel supplies—coal, oil, gas—are limited, but also the cheap supplies of uranium from which the easily fissionable uranium isotope U-235 is obtained. The U-235 content is only 0.7% in natural uranium; the main content is the hard-to-fission U-238. Thus without the building of nuclear reactors which convert U-238 or the equally readily available thorium isotope Th-232 into a useable form, nuclear power plants would merely be able to ensure the energy supply for a few decades. However, fast breeder reactors can produce plutonium from U-238 or U-233 from Th-232 in sufficient quantities together with energy. Fast breeder prototype nuclear power plants are already in operation or are being built or planned in several countries. (GE)

31847 NUCLEAR INSTALLATION FOR THE GENERATION OF ENERGY. Grishanin, E. I.; Iljunin, V. G.; Kuznetsov, I. A.; Murogov, V. M.; Shmelev, A. N. French Patent 2,184,066/A/. 10 May 1973. 20p. (In French).

31848 LIQUID COOLED REACTOR WITH FUEL ELEMENTS WHICH ARE FLOWED THROUGH BY COOLANTS AND HAVE AN ADJUSTABLE APERTURE FOR THE VARIATION OF THE FLOW-IN CROSS SECTION. Rothfuss, H. (to Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). German(FRG) Patent 1,564,140/B/. 30 May 1973. 6p. (In German).

An invention is described whose object is to control the coolant rate of flow for the single fuel elements of a liquid metal cooled nuclear reactor. It should be possible at any time without interrupting the operation of the reactor to influence the coolant passage and to arbitrarily change the temperature distribution over the core cross-section with little technical effort, independent of the type of coolant used. The technical details of the mechanism for controlling the effective opening of the aperture in the fuel element are described. (GE)

31849 AN ELECTROMAGNETIC PUMP FOR SODIUM. (to UKAEA). French Patent 2,182,078/A/. 25 Apr 1973. 13p. (In French).

An electromagnetic pump designed for pumping liquid sodium is described. It consists of a central core placed in a hole of a pump casing coaxial to the longitudinal axis of the core, an annular flow passage placed between the wall of the core and the wall of the hole, a three-output helical winding coaxial to the longitudinal axis of the core. The pump can be applied to the pumping of coolant sodium for nuclear reactors. (tr-auth)

31850 NUCLEAR-REACTOR CORE SUPPORTING GRID. Lebeu, J. (Societe pour l'Industrie Atomique (SOCIA), 75 - Paris (France)). (to CEA, 75 - Paris (France); Societe Creusot-Loire, 42 - Unieux (France)). French Patent 2,180,517/A/. 19 Apr 1972. 13p. (In French).

This grid comprises a casing consisting of two metal plates, the upper one being plane and the core axis being vertical. It is characterized in that the lower bottom plate is in the shape of a sphere portion and in that the upper bottom plate is provided with a circular flange which is in parallel relationship with a peripheral web of the lower plate, said flange and web being connected by cross-bars and said upper flange resting on an annular girder girdling the vessel, while the plane web of said lower plate is supported by a flat circular member integral with the vessel. (FR)

31851 PARACHUTE-LIKE BRAKE, IN PARTICULAR FOR THE FUEL-ASSEMBLY TRANSFER CARRIAGES OF NUCLEAR REACTORS. Chabassier, R. (Societe d'Exploitation des Materiels Hispano-Suiza, 92 - Bois-Colombes (France)); Delemontey, R. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92 - Le Plessis-Robinson (France)); Michoux, H.; Pomie, P. (CEA, 75 - Paris (France)). (to CEA, 75 - Paris (France)). French Patent 2,192,057/A/. 10 Jul 1972. 16p. (In French).

This brake is characterized in that it comprises a body adapted to slide along a guide-ramp and to support the transfer carriage through connecting yokes, this body being provided with transverse shafts at angles to the ramp carrying braking cams, successively comprising, at the periphery thereof, an abutment shoulder, a spirally-shaped portion and a cogged portion adapted to cause the cam to pivot about its axis under the control of a rack carried by a slide-block movable along the brake-body axis. This brake can be applied to the fuel-assemblies of fast neutron reactors. (FR)

31852 INVESTIGATION OF INTRA-VESSEL SHIELDING FOR THE BN-600 REACTOR OF THE BFS-2 RIG. Bakov, A. T.; Bondarenko, V. V.; Voropaev, A. I; Efimov, E. F.; Kazansky, Yu. A.; Kulakovsky, M. Ya.; Savitsky, V. I.; Troyanov, M. F.; Fomenko, V. P.; Khokhlov, G. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). pp v.1 p.24-57 of Proceedings of the 4th international conference on reactor shielding. Paris, France; Eyrolles ([nd]). (In English and Russian).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The intra-vessel shielding of the BN-600 reactor consists of a set of steel plates adjacent to the core and several rows of vertical steel tubes filled with graphite in the peripheral part of the shielding. Experiments carried out on the BFS-2 rig to investigate heterogeneity effects in the tube section of the shielding are described. Calculated data on space-energy neutron flux distributions are also presented and compared with experimental results. (FR)

31853 TRANSFER HOOD. Aubert, M.; Merland, D. (CEA, 75 - Paris (France)); Renaux, C. (Societe Financiere et Industrielle des Ateliers et Chantiers de Bretagne, 75 - Paris (France)). (to CEA, 75 - Paris (France)). French Patent 2,188,251/A/. 8 Jun 1972. 14p. (In French).

The description relates to a transfer hood for nuclear reactors (e.g. fast neutron reactors) comprising a core within a protective vessel and a storage enclosure. This hood permits the transfer of fuel assemblies between at least two slanting ramps equally inclined to the vertical one which penetrates into the vessel while the other penetrates into the storage enclosure. It is characterized in that it comprises at least one shielded duct open at the lower portion thereof and equally inclined to the vertical with the ramps, the duct being connected to a movable portion of the hood adapted to rotate about a vertical axis and so arranged that the shielded duct comes into register with one ramp or another according to requirements. (FR)

31854 CONFINEMENT AND FILTRATION OF AEROSOLS PRODUCED BY A SODIUM FIRE ON A FAST BREEDER REACTOR. Colome, J.; Guerin, P.; Jacques, J.; Malet, J. C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Service d'Etudes de Surete Radiologique). pp 437-466 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

After a short development on the behavior of aerosols in a confined atmosphere, the transfer of sodium aerosols is studied at two reactor levels: secondary confinement and filtration apparatus. Experiments realized in a 400 m^3 containment equipped with numerous thermodynamic and granulometric measurement sets are designed. The influence of different parameters contributing to the aerosols deposition on the confinement structures and walls is studied. The evolution of the particles average concentration inside the confinement has been observed on several experiments. For the most important of them more than 300 kg of sodium have been used. For different sodium aerosol sizes,

the efficiency of industrial filters has been measured. The results are discussed and further studies are considered. (FR)

31855 CENTRALIZED INFORMATION PROCESSING OF PHENIX RADIOPROTECTION. Nicolo, G. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). pp 481-498 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The general characteristics of the PHENIX Reactor are recalled. Analogic and logic centralized information treatment of the radioprotection is described. Time acquisition, supervision, restitution and data processing, especially the conversion of electrical magnitudes into physical magnitudes are given. (FR)

31856 THE CREYS-MALVILLE NUCLEAR POWER PLANT. A Fast-Neutron Demonstration Power Plant. Robert, E. Tech. Mod.; 66: No. 9, 39-41(Sep 1974). (In French).

The French nuclear program on the development of fast neutron reactors is presented. The characteristics and the planning for the construction of Super-Phenix are given. (auth)

31857 NUCLEAR REACTOR. Aubert, M.; Collion, H. J.; Verriere, P. (to CEA, 75 - Paris (France)). French Patent 2,195,822/A/. 8 Aug 1972. 11p. (In French).

The fast neutron reactor comprises a main vessel and a primary vessel containing sodium for cooling the reactor core and pump-exchanger units for circulating the sodium and extracting the heat absorbed through the core. The invention consists in using pipes for channeling hot sodium leaving the core toward the exchangers, the pipes being immersed in the primary vessel and leading to an annular space defined by each exchanger and a coaxial sleeve. That space is submitted to an adjustable negative-pressure so as to ensure the continuous flow of sodium toward the exchanger in the manner of a siphon. Such an arrangement ensures the confinement of the hot sodium within the primary vessel, while protecting the adjacent reactor structures against thermal expansion. (FR)

31858 A METHOD FOR DETECTING NON-TIGHT FUEL ELEMENT BUNDLES IN A LIQUID METAL COOLANT REACTOR, A DEVICE FOR CARRYING OUT SAID METHOD AND A LIQUID METAL COOLANT REACTOR PROVIDED WITH THAT DEVICE. Aristarkhov, N. N.; Efimov, I. A.; Zaitsev, B. I.; Peters, I. G.; Tymosh, B. S.; Filonov, V. S.; Sharov, A. L.; Shildin, A. I.; Bets, N. I.; Kevrolev, V. P. French Patent 2,202,341/A/. 5 Oct 1973. 25p. (In French).

The invention concerns the procedures and apparatus for the detection of fuel element bundles containing non-tight elements in a reactor with liquid metal coolant. Before taking the coolant sample, the gas is accumulated in the coolant of the bundle to be tested (the reactor is shutdown), then separated from the sample using an inert gas carrier, and then measured for its radioactivity. (FR)

31859 BNES INTERNATIONAL CONFERENCE ON FAST REACTOR POWER STATION. Conference Report. Baker, A. R. (United Kingdom Atomic Energy Authority, Risley, Eng.). Ann. Nucl. Sci. Eng.; 1: No. 7/8, 463-474(Jul 1974).

At the conference, held in London in March 1974, there were five plenary sessions devoted to past and current experience and to future plans for incorporating fast reactors into the electrical supply networks. Six specialist sessions were devoted to: steam generators; nuclear performance; core including fuel; control, dynamics and hydraulics; coolant management; and fuel handling and other mechanisms. The main points raised in the papers are summarized and, in a final section, an assessment is made of the conclusions to be drawn from the information presented. (auth)

31860 LIQUID METAL SUPERHEAT IN FORCED CONVECTION. Winterton, R. H. S. (Univ. of Birmingham, Eng.). Int. J. Heat Mass Transfer; 18: No. 2, 205-212(Feb 1975).

Analysis of inert gas mass transfer in systems used for the experimental measurement of superheat shows that the flow is likely to contain gas bubbles that have come out of solution, and the number of bubbles will increase rapidly if the velocity in the cold pipework, where the bubbles are precipitated, is raised. The effect these bubbles could have on superheat measurements is examined. Depending on the way in which the experiment is conducted, there can be an apparent effect of increasing superheat as the heat flux or temperature ramp is increased, or decreasing superheat as the flow velocity is increased. (auth)

31861 GAS-COOLED REACTORS: A WAY OF FULFILLING THE NATIONAL OBJECTIVES OF NUCLEAR REACTOR DEVELOPMENT. Schlueter, G. 74-WA/NE-13. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The technical features of the Gas-Cooled Fast Breeder Reactor (GCFR) are discussed. Because of its excellent nuclear performance characteristics, the GCFR is a good breeder choice for a partnership with High-Temperature Gas-Cooled Reactors (HTGR): GCFR's can breed ^{233}U in thorium blankets around the core and supplement the recycled supply of this material in the fuel feed of HTGR's. With today's breeder fuel and reactor technology, the GCFR would be capable of economically providing the fissile requirements to a substantial portion of the future United States nuclear power capacity. 5 references. (auth)

31862 URANIUM UTILIZATION AND THE COMMERCIAL LMFBR. Horst, K. M.; Sciacca, F. W.; Gibson, A. S. 74-WA/NE-11. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Breeder reactors are projected to play a major role in supplying future U. S. electrical energy needs. The potential of the breeder lies in its ability to extract large amounts of energy from relatively little resources. This special ability of the breeder can contribute significantly to the conservation of our uranium resources. For the promise of the breeder to be realized, this plant concept must become a commercial reality and must be widely deployed. The capital cost targets which breeder plants must meet in order to become competitive are presented. The ingredients necessary for these plants to meet their capital cost targets are discussed. Development of commercial breeders must be significantly accelerated if we are to avoid the economically and environmentally costly exploitation of our low grade uranium resources. 10 references. (auth)

31863 FUEL CONSERVATION IMPLICATIONS OF THE BREEDER REACTOR. Voltin, M. J.; Schmidt, P. S. 74-WA/NE-12. New York; American Society of Mechanical Engineers (1974). 9p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The influence of the breeder reactor timetable on national demand for coal, oil, gas, and enriched uranium as power generation fuels for the period 1986–2010 is analyzed. AEC projections for market penetration of the liquid metal fast breeder are discussed for three scenarios: no breeder, breeder introduction in 1986, and breeder introduction in 1990. Total requirements for both fossil and nuclear fuels are presented for each of the three scenarios. The indirect implications of displacement of fossil fuels by the breeder are also considered. Specifically, transportation and environment-associated factors are enumerated in quantitative terms. The contribution of the breeder in meeting the national goal of energy self-sufficiency is discussed in terms of proven domestic reserves. 8 references. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 29030, 29669, 30192, 31327, 31809, 31810, 31835, and 31879.

31864 (AED-CONF-74-571-020) REACTOR PHYSICS MEASUREMENTS PERFORMED IN CRITICAL ASSEMBLY TCA AT JAERI. Matsuura, S.; Kobayashi, I.; Tsuruta, H., Suzaki, T.; Ohno, A.; Murakami, K.; Yumoto, R.; Matsumoto, T.; Sasajima, H. 1974. 24p. INIS.

From panel on plutonium utilization in thermal power reactors; Karlsruhe, F. R. Germany (25 Nov 1974).

7 figs.; 9 tabs.; 11 refs. With abstract.

Critical experiments and analyses were carried out to obtain information on the reactor physics properties of light-water moderated PuO_2-UO_2 lattices in simple configurations from 1972 to 1974. The fuel material was 3.0 wt % PuO_2-UO_2 pre-sintered pellets with a density of 6.1 g/cm^3. The isotopic composition of the plutonium was 68, 7, and 2 wt % for ^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu, respectively. Five kinds of square lattices were used, and their ratios of atomic number densities of hydrogen to plutonium, H/Pu were 295, 402, 494, 704 and 922. The measured items were critical dimensions, activation traverses by gold wires, power distributions and β_{eff}. The calculated results based on the few-group two-dimensional diffusion scheme were correlated with the measured results. (auth)

31865 (ANL-8133) INVESTIGATIONS OF MATERIALS COMPATIBILITY RELEVANT TO THE EBR-II SYSTEM: FY 1974. Ruther, W. E.; Hurst, H.; Greenberg, S.; Olson, N. J. (Argonne National Lab., Ill. (USA)). Nov 1974. Contract W-31-109-eng-38. 35p. AT.

Due to the continuing low incidence of failure and replacement in EBR-II, no components were available during FY 1974 for destructive examination. The annual inspection of the steam-generating plant is described. Uniform corrosion is $<10^{-3}$ in. for both steam-generating and steam condensing surfaces after about nine years of service. Perforation of a fuel-element cladding in subassembly X106 was ascribed to the accidental incorporation of polyvinyl chloride particles into the interior of the fuel element. Failure of shroud tubes in subassembly X159 was probably related to overetching of the tubing by the manufacturer, although the source of tensile stress on the shroud tubes remains unclear. A crack in a branch weld of a steam line was a result of poor weld-joint preparation and stresses introduced by the restriction of movement of the branch line as the steam plant cycled between standby and power generation. A possible mechanism was derived experimentally to help explain the slow increase of tin concentration in the EBR-II primary sodium and the formation of bismuth-rich deposits on the argon side of the trough wall of the EBR-II rotating seal. (19 references) (auth)

31866 (FWR-35(Rev. 0)) INTERMEDIATE HEAT EXCHANGER FOR FAST FLUX TEST FACILITY. Elastic–Plastic-Creep Analysis of a Thick-Walled Cylinder Subjected to Time Dependent Pressure, Temperature, and Axial Loads or Displacements. Chern, J. M. (Foster Wheeler Corp., Livingston, N. J. (USA)). 25 Jul 1972. 130p. AT.

For Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.

An analytical solution to the elastic-plastic-creep problem of a long thick-walled cylinder under cyclic loading conditions is presented. Time dependent internal/external pressure, thermal gradients, as well as axial tractions or displacements can be applied in a nonproportional manner. An efficient program has been written to yield results at a nominal computational cost, even for complicated load histories. The solution incorporates the latest ORNL recommended constitutive relationships which will be incorporated into RDT Standard F-9. This program is a substantial improvement over Bree's technique and is an excellent design aide for components operating in the creep range. The problem formulation, solution scheme, detailed derivation, the user's manual and listing of the computer program are presented. Also included are results of a set of sample problems to illustrate the practical application of this program. (16 references) (auth)

31867 (NRO-671859) DESIGN MODIFICATION AND ANALYSIS OF LOFT CONTAINMENT-VESSEL RAILROAD DOOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 21 Apr 1967. 35p. Dep. NTIS $4.75.

The program proposed for providing engineering services to the US AEC, Idaho Falls, Idaho, for support of the LOFT containment vessel railroad door is described. This program will be based on the recently completed, LOFT Containment Vessel Railroad Door Feasibility Study. The approach to be taken will incorporate the necessary design changes into detailed engineering sketches providing sufficient detail to enable the customer to prepare fabrication drawings. A report will be issued establishing the structural integrity of the containment vessel within the requirements of Section III of the ASME Nuclear Vessel Code. (auth)

31868 (ORNL-TM-4811) BULK SHIELDING FACILITY QUARTERLY REPORT, JULY, AUGUST, AND SEPTEMBER OF 1974. Hurt, S. S. III; Lance, E. D.; Thomas, J. R. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 37p. Dep NTIS $5.00.

The BSR remained shut down until September 10, 1974, for completion of repairs to and repainting of the pool walls and floor. This accounted for 67% of the downtime during July, August and September. The BSR operated at an average power level of 1,514 kw for 15.68% of the time during the quarter. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. There were no unscheduled shutdowns during the quarter. (auth)

31869 EXAMINATION OF LOFT SCALING. Ybarrondo, L. J.; Fabic, S.; Griffith, P.; McPherson, G. D. 74-WA/HT-53. New York; American Society of Mechanical Engineers (1974). 19p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The thermalhydraulic scaling concepts and selected compromises required in the design of the Loss-of-Fluid Test (LOFT) experimental system are described. The effect of these compromises on the objectives of the LOFT program is analyzed. A concise overview of the development of the LOFT program and its present objectives is appropriate and is presented. 19 references. (auth)

31870 EMERGENCY COOLING OF THE RAPSODIE-FORTISSIMO CORE. Chenal, J. C.; Pontier, R.; Delisle, J. P. 74-WA/HT-51. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

For the irradiation reactor Rapsodie-Fortissimo, a fast external loop reactor, possible solutions for emergency cooling of the core in case of sodium leakage leading to the draining of the primary loops are studied. The afterpower is extracted by nitrogen circulating in the double shell of the vessel, which induces natural sodium convection in the core. Calculations have shown that in steady-state operation, a power of 300 kW may be evacuated in this way, and that excessive temperatures are not reached provided that forced sodium convection is maintained for at least six minutes after reactor shutdown. Testing confirmed the steady-state calculation code, and also showed that nitrogen-sodium heat transfer is greater than expected, while the temperature range in the sodium over the assemblies is slightly different from the calculated range. (auth)

31871 QUANTITATIVE MEASUREMENT OF THE FISSION PRODUCT MIGRATION IN AN IRRADIATION DEVICE BY THE IN-PILE GAMMA SCANNING. Michel, F.; Perves, J. P.; Valovic, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Piles); Hairion, J. P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). Bull. Inform. Sci. Tech. (Paris); No. 196, 77-84(Oct 1974). (In French).

A gamma scanning device was set up on the SILOE reactor for examining nuclear fuels without removing the sample. Its purpose was to study the axial and radial distribution changes of fission product in the fuel and their migration in the device during irradiation. The half-lives of the fission products detectable against a high activation background extend from an hour to a few years. A quantitative measurement adjustment is made by different methods to obtain values in numbers of atoms. The results enable the irradiation conditions to be known better and access to be obtained for the study of the migration techniques of the fission products. (FR)

31872 CONTAINMENT SYSTEMS OF THE ATMOSPHERIC RADIOACTIVITY AND CONTROL METHODS USED IN THE CENJV OF JEN. Crespi, M. A. (Junta de Energia Nuclear, Madrid (Spain)). pp 509-524 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Some of the gas confinement problems which exist at the Centro de Energia Nuclear Juan Vigon of Junta de Energia Nuclear (Spain), the technical solutions relative to the ventilation and air cleaning installations, and the containment parameters are presented. The activities of the Grupo de Estudios de Contencion of JEN relative to the development of the quality control methods for containment are described: containment tightness measurements, tests of air cleaning components, and tests of exhaust systems. Tightness studies are presented: design of a testing stand for containment materials and component units; measurement method of a semi-tight containment system; testing methods of nuclear reactor tight containment systems. The studies realized in the aerosol particle size measurements are described and the conclusions drawn from the influence of several generating parameters on the particle size are given. (FR)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 31769, 31785, and 31786.

Propulsion and Package Reactors

Refer also to abstracts 29080, 29339–29344, 29346, 29349–29377, 29379–29407, 29409, 29410, 29517–29519, 29535, 29734, 29736–29739, 29747, 30086, 30097, 30142, 30145, 30146, 30171, 30173, 30191, 30198, 30282–30284, 30286, 30288, 30316–30320, 30355, 30362, 30364–30367, 30376, 32191–32195, 32300–32306, 32366, 32368–32370, 32372–32374, 32445, 32446, 32449, and 32450.

31873 (ACF-411-270) NRX-A4/EST PRIVY ROOF MOUNTED SHIELD AND SUPPORT TEST REPORT. Arnold, C. E. (ACF

Industries, Inc., Albuquerque, N. Mex. (USA)). 29 Nov 1965. 37p. Dep. NTIS $5.00.

The results of testing the NRX-A4/EST Privy Roof Mounted Shield and Support, in accordance with Procedure #ACF-411-261, are presented. All components successfully met or exceeded the design requirements for structural integrity. Pressure drops between the Simulated Reactor Support Test Stand and the Support exceeded design requirements but were acceptable within over-all system requirements. Other flow parameters were within design requirements. (auth)

31874 (AGC-749N-TP) TEST SPECIFICATIONS FOR THE STATIC STRUCTURAL TEST OF THE NERVA UPPER THRUST STRUCTURE, S/N 0000001, P/N 280200. George, A. P. (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 Jul 1963. 20p. Dep. NTIS $4.00.

The Upper Thrust Structure is conical in shape and located between the RIFT vehicle and the Lower Thrust Structure. The thrust structure assembly serves to transmit thrust and inertia loads between the RIFT vehicle and the pressure vessel. The purpose of this test is to substantiate the structural integrity of the NERVA Upper Thrust Structure when subjected to design loads at the RIFT joint. Test loads will be applied to duplicate the axial load and moment at the RIFT joint and the gimbal actuator loads, per NERVA TCA Loads Document 9443-63-16, Revision A. All remaining test loads will act as balance loads. The objectives are to: Determine the structural integrity of the Upper Thrust Structure when subjected to static limit loads; determine the lateral and axial stiffness of the structure; provide information on the amount of thrust misalignment due to thrust structure deflections; permit a correlation of experimental and theoretical data; and provide information for design improvement. These objectives will be accomplished utilizing stresscoat, strain, and deflection gages. (auth)

31875 (AGC-904N-TP) TEST SPECIFICATIONS FOR LEAKAGE TESTS OF NERVA ENGINE PRESSURE VESSEL METALLIC SEALS. Catte, A. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Aug 1963. 25p. Dep. NTIS $4.25.

This test specification is written in accordance with Test Plan Report No. 9443-63-11, for the pneumatic leakage test of the NERVA Engine Pressure Vessel Metallic Seals. Pneumatic pressure tests of the assembled specimen will be conducted to serve as a means of comparison with the maximum permissible leakage rate of 10^{-2} standard cubic centimeters per second, per inch of seal diameter. Pneumatic pressure tests at ambient temperature will be conducted in three increments using a helium testing medium in a one zone pressure system. The increments will be of fifty, seventy-five, and one hundred percent of pneumatic proof pressure. Leakage gas pressure will be balanced in sealed neoprene manifolds, allowing leakage to be transmitted via tygon tubing to the helium collecting instrument for measurement. The test specimen hardware design will allow for the simulated thrust reaction forces to be directed to the forward closure. (auth)

31876 (AGC-909N-TS) TEST SPECIFICATIONS FOR THE STATIC STRUCTURAL TEST OF NERVA ALUMINUM PRESSURE VESSEL, S/N 0000003, CYLINDER 294053, FORWARD CLOSURE 298252. Hales, F. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 8 Nov 1963. 26p. Dep. NTIS $4.50.

The primary objectives of this test are: Ascertain joint rotation and deflection during one zone pressurization; determine control drum port deflections for reactor interface analysis; to check on interface reactions under different flange preloads for the forward closure and nozzle; and correlate analytical and actual test results. To gain the desired data and satisfy the test objectives, one test phase consisting of three pressure cycles each, at four different flange preload levels will be conducted on a fully instrumented test assembly. Throughout the twelve pressure cycles a continuous recording of all instrumentation channels consisting of biaxial strain gages, rectilinear transducers and deflection reeds will be made, thus providing a check for repeatability on unit performance. (auth)

31877 (AGC-2487) REON RELIABILITY AND QUALITY ASSURANCE PROGRAM PLAN. (Aerojet-General Corp., Azusa, Calif. (USA)). Feb 1963. 98p. Dep. NTIS $8.00.

The detailed plans by which they intended to achieve reliability and quality assurance are presented. Procedures are defined, organizational responsibilities are allocated, etc. and provision is made for design review, documentation, audits, corrective action, traceability, etc. (LTN)

31878 (AGC-2502) BASIC CRITERIA ENGINE TEST STAND NO. 2 AT NRDS. (Aerojet-General Corp., Azusa, Calif. (USA)). Jul 1963. 143p. Dep. NTIS $10.25.

Declassified 11 Aug 1967.

Data obtained through an evaluation of the NERVA Engine Development Test Requirements is presented. Contained in the report are the operational requirements for the NERVA Engine, the Engine Static Test Complex Utilization, engine test stand (ETS-2) Functional Requirements, engine test stand (ETS-1) and ETS-2 Integration. All are assembled and related to form the Basic Criteria for the ETS-2, and to integrate it into the Engine Static Test Complex at NRDS. The basic criteria presented forms the basis, compatible with the NERVA engine program requirements, for proceeding with the design of the ETS-2 and its integration with ETS-1. (auth)

31879 (AGC-2510(Add.)) FINAL TEST SPECIFICATIONS FOR PHASE I OF THE COUNTERMEASURES RADIATION EFFECTS PROGRAM. (Aerojet-General Corp., Azusa, Calif. (USA)). Dec 1963. 243p. Dep. NTIS $15.25.

Phase I of the Countermeasure Radiation Effects Program will be performed in the Small Trial Cable Facility of the General Electric Test Reactor Vallecitos, Pleasanton, California. Small amounts (3.6 g) of the subject materials are scheduled to receive an initial radiation dose of 3×10^{16} nvt with subsequent dosages of 1×10^{16} nvt or 1×10^{17} nvt. The subsequent radiation levels are tentative and will depend for the most part upon results of the initial radiation of each material. Pre- and post-irradiation measurements will include impact sensitivity, melting point, vacuum stability, differential thermal analysis, color and microscopic changes of each material. The irradiation capsules are being fabricated, loaded, tested, and delivered by the Aerojet-General–Downey Ordnance Research Division. The irradiation capsules have been designed to withstand an internal detonation of twice the amount of explosive to be irradiated. (auth)

31880 (AI-AEC-12806) SNAP 8 DEVELOPMENT REACTOR FUEL ELEMENT FABRICATION. McClelland, D. T. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1969. Contract AT(04-3)-701. 56p. Dep. NTIS $6.00.

Declassified 27 Aug 1973.

221 fuel elements were fabricated for the SNAP 8 Development Reactor core. They consisted of enriched uranium–zirconium hydride fuel rods, sealed in ceramic-coated Hastelloy N cladding tubes. In addition, 56 fuel elements containing normal uranium–zirconium hydride fuel rods were fabricated for the nonnuclear environmental testing programs. The fuel rods were triple arc melted and double extruded to achieve maximum homogeneity. The average uranium composition was 10.58 wt % U (10.50 ± 0.30 wt % required). The fuel rods were hydrided to 6.07×10^{22} atoms of hydrogen/cc of fuel alloy ($6.00^{+0.45}_{-0.30} \times 10^{22}$ required). The hydrogen barrier material was a ceramic applied in two coats to the inside of a Hastelloy N tube with the burnable poison (samarium oxide) included in the second coat. Total weight of the samarium oxide was 12.06 g (12.5 ± 1.2 g required). Each fuel rod was contained in a coated cladding tube, with a coated cup plug inserted, welded, and sealed in the open end, resulting in a completely sealed envelope of ceramic around the rod. The average hydrogen permeation rate at 1400°F was 0.34 cc of H_2 (STP)/h, compared to the specified maximum average of 0.50 cc of H_2 (STP)/h. (DLC)

31881 (AI-AEC-12963) EFFECTS OF IRRADIATION ON HYDRIDED ZIRCONIUM–URANIUM ALLOY NAA 120-4 EXPERIMENT. Davies, N. F.; Forrester, R. E. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1970. Contract AT(04-3)-701. 61p. Dep. NTIS $6.25.

Declassified 4 Sep 1973.

In the NAA 120-4 Experiment, 17 fuel specimens were irradiated simultaneously in a single facility at the Hanford K-East Reactor, to a target burnup of ~0.9 metal at.%. The experiment was statistically designed to evaluate the performance of SNAP fuel materials as a function of fuel composition and temperature. The specimens were contained in five separate experimental units, which provided a means of controlling the maximum fuel temperatures at different levels, ranging from 1300 to 1600°F. Design compositions included 1.70 and 1.85 H/Zr ratios. The maximum temperature of the Hastelloy X cladding and the hydrogen barrier (SCB-1 ceramic) did not exceed 1300°F for any extended periods. Burnup analysis showed that the NAA 120-4 Experiment achieved a burnup within 10% of its target requirements. Postirradiation examination showed that the cladding was intact on all 17 fuel specimens. Disassembly of the fuel specimens showed cracking had occurred in 8 of the 17 central fuel sleeves (test fuel specimens). Besides exhibiting a strong temperature dependence for fuel swelling, this experiment also confirmed the existence of the postulated "offset" fuel growth which saturates early in life. This report describes the fuel element fabrication, experiment design, and hot laboratory examination. (auth)

31882 (ANSC-TE001-W389f) NERVA TELEOPERATOR STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 215p. Dep. NTIS $13.75.

The NERVA Teleoperator Study Program was initiated to define a program plan to provide a qualified operational space teleoperator system by 1980 and to accelerate the maintenance analysis and maintainability design effort associated with the NERVA flight phase. The basic definition of a NERVA teleoperator is a remotely-operated machine which must perform the normal, maintenance, and repair operations on the reusable nuclear vehicle in earth orbit. The person in control of the teleoperator is to be in a non-hostile environment and must have a sense of presence at the work station through the teleoperator systems. The intent of the study program was to establish a preliminary space teleoperator concept, setting a firm foundation for a program to follow for the detailed design, development, and qualification of a space teleoperator system. The NERVA program defines a requirement for a teleoperator both in the ground-test and the flight programs. Through the use of a teleoperator system, maintenance and repair operations can be performed with the use of space support equipment which imposes essentially no penalties upon the NERVA system. With a totally remote teleoperator, work can be performed without exposing man to the hostile radiation environment. (auth)

31883 (ANWA-PEP13-W395) PROPULSION/ELECTRICAL POWER GENERATION. Final Report. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 143p. Dep. NTIS $10.25.

The feasibility of utilizing the NERVA engine as a heat source for a 25-kW(e) electrical power system was investigated. A closed loop, independent of the normal NERVA flow path, was identified as a practical solution to the engine portion of the primary coolant loop. Warm hydrogen circulating in the primary loop carries heat from the engine to the forward end of the stage where it supplies heat to a boiler. An organic working fluid, thiophene, was selected as the most desirable fluid for the Rankine-cycle power-conversion system. A wick-type condenser was conceived for operation in a zero-gravity environment. The heat-rejection system utilizes gaseous hydrogen to conduct heat from the condenser to the exterior surface of the stage. Multiple loops in the radiator provide a large number of parallel independent loops to enhance reliability and reduce the potential effects of meteoroid damage. The operating characteristics of the NERVA electrical system enhance the operation of the nuclear rocket engine by providing a radiative means of dissipation of decay thermal energy. Thus, cooldown impulse may be reduced by 30%, cooldown propellants reduced by 50%, and the cooldown thrusting period reduced by 90%. This increased operating flexibility is especially important for short-duration missions from a guidance, navigation, and docking standpoint. For interplanetary missions, the electrical power could be used to re-liquefy boiloff hydrogen. From a weight tradeoff standpoint, this is desirable because the propellant recovery is expected to be an order of magnitude greater than the hardware weight of the NERVA electrical system. (auth)

31884 (APEX-573) INTERIM REPORT ON ADVANCED CORE TEST HAZARDS. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 26 Sep 1960. Contract AT(11-1)-171. 261p. Dep. NTIS $16.25.

Declassified 12 Sep 1973.

A description of the Advanced Core Test assembly and an evaluation of the hazards associated with the operation of this assembly are presented. (auth)

31885 (BNWL-1366) EXAMINATION OF ROVER EXPERIMENT 50 FUEL ELEMENTS. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1970. Contract AT(45-1)-1830. 90p. Dep. NTIS $7.50.

Declassified 28 Aug 1973.

Twenty-seven Experiment 50 fuel elements were examined to determine the effects of experimentally varied porosity in ROVER fuel. Microscopy and radiography were used to perform comprehensive analyses of samples removed from stations that represented peaks in MULE weight-loss profiles or exhibited unusual corrosion effects. Corrosion effects in elements that were hot-gas tested have been characterized according to type, intensity and probable cause. The many variables of hot-gas testing and fuel element fabrication were considered in relating the causes and effects of observed corrosion. Generally, the addition of wood flour to the graphite mix of certain elements was observed to aid NbC rooting and thus reduce coating-to-matrix separation. However, while reducing corrosion caused by coating crack enlargement, the wood-flour addition increased corrosion caused by pitting. The presence of fuel particles in the graphite mix was shown to aid in the reduction of bore corrosion. The bore-to-blanket differential gas pressure gradient and the testing temperature were shown to be the most critical testing variables affecting the severity of corrosion. (auth)

31886 (GA-8917) DESIGN STUDY OF THE UNIT-CELL THERMIONIC REACTOR FOR SPACE APPLICATION. Final Report. Allen, D. T.; Fisher, C. R.; Heath, C. A.; Homeyer, W. G.; Mathews, D. R. (Gulf General Atomic Co., San Diego, Calif. (USA)). 13 Jan 1969. Contract AT(04-3)-167. 364p. Dep. NTIS $21.25.

Declassified 5 Mar 1975.

Reference designs for a 300 kW(e) and a 3 MW(e) reactor have been developed and analyzed. Parametric studies were performed to help select the reference design fuel element and to determine its performance and applicability over a broad power range. The effects of the heat rejection system and electrical transmission lines on the reactor were also studied parametrically. Engineering analyses of temperatures and thermal and mechanical stresses and neutronic analyses of power distributions, reactivity worths, and neutron lifetimes were performed. The transient responses of the controlled and uncontrolled reactor were studied, and a reliability analysis was conducted. (auth)

31887 (GEMP-176) 710 REACTOR PROGRAM, QUARTERLY REPORT No. 2, OCTOBER 1–DECEMBER 31, 1962. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 31 Jan 1963. Contract AT(40-1)-2847. 56p. Dep. NTIS $6.00.

Declassified 4 Sep 1973.

Information is presented concerning the development of refractory-metal fuel elements, critical experiments and reactor physics, and control and stability analysis. (DCC)

31888 (GESR-2126) DEVELOPMENT OF A SPACE THERMIONIC REACTOR POWER PLANT. Sixth Periodic Progress Report, March 1–June 30, 1970. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Nuclear Center). [nd]. Contract AT(04-3)-771. 139p. Dep. NTIS $10.00.

Declassified 3 Mar 1975.

Information is presented concerning emitter and joint development and sheath insulator fabrication, thermionic fuel element development, thermionic reactor physics, TREX control studies, and systems technology. (16 references) (DCC)

31889 (GTR-11) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 11 Feb 1964. 93p. Dep. NTIS $7.75.

An experiment was performed utilizing the NARF Ground Test Reactor to determine the effects of combined reactor radiation and cryogenic (LN_2) temperatures on linear motion displacement transducers, WANL strain gages, development strain gages, dome-end support ring sections, and cork board insulation. These components were of the type proposed for the NERVA engine. The experimental design encompassed three prime objectives: (1) to determine radiation rate (transient) effects on the electrical characteristics of the test items, (2) to determine the effects of total radiation exposure on these characteristics, and (3) to determine abilities to recover these electrical characteristics after removal from the radiation field. (auth)

31890 (GTR-14) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 23 Jul 1964. 94p. Dep. NTIS $7.75.

A series of tests is being performed at the Nuclear Aerospace Research Facility (NARF) of General Dynamics/Fort Worth to determine the effects of nuclear radiation on components proposed for inclusion in the NERVA engine. Aerojet-General Corporation (AGC), Azusa, California, has prime responsibility for development of the NERVA engine; the incorporated nuclear reactor is being developed by Westinghouse Astronuclear Laboratory (WANL), Large, Pennsylvania. The items tested included three piezoelectric accelerometers, three LVDT pressure transducers, six resistance temperature transducers, and eight thermocouples. All test components and special test fixtures were provided by AGC. (auth)

31891 (LA-3398-MS) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING AUGUST 31, 1965. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1965. Contract W-7405-eng-36. 157p. Dep. NTIS $11.00.

Declassified 28 Aug 1973.

The full power test of PHOEBUS-1A was conducted successfully on June 25, 1965. The reactor was held at full power for 10½ minutes before a loss of coolant resulted in overheating and ejection of core parts. The experimental results and postmortem examination are detailed. Design drawings have been released for PHOEBUS-1B fabrication. PHOEBUS-2 progress is outlined (thermal analysis, fabrication, reactivity calculations, effect of hydrogen, structural analysis, etc.). Test facility operations are described. Fuel element development is summarized and some fundamental studies (such as two-phase flow, alloy development, phase studies, etc.) are discussed. (LTN)

31892 (LA-3490-MS) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING FEBRUARY 28, 1966. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1966. Contract W-7405-eng-36. 143p. Dep. NTIS $10.25.

Declassified 28 Aug 1973.

Further analyses of the PHOEBUS-1A full power test and postmortem examination are reported. PHOEBUS-1B design, analysis, and predicted performance calculations are progressing. Similarly, PHOEBUS-2 progress is described. Test facility operations and construction are described and fuel element and graphite research and development are summarized. (LTN)

31893 (LA-3637-MS) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING NOVEMBER 30, 1966. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1966. Contract W-7405-eng-36. 134p. Dep. NTIS $9.75.

Declassified 29 Aug 1973.

Progress in fabrication or design of the PHOEBUS-1B, PHOEBUS-1C, and PHOEBUS-2 reactors is reported. Various phase diagram and thermodynamic studies, methods of testing or examination, etc. are reported. Coatings research (to minimize corrosion of graphite) is discussed. Studies of flight safety (involving poison wires, chemical explosive destruct systems) are treated briefly. Computer calculations involving heat transfer, thermal gradients, etc. are reported. (LTN)

31894 (LA-3679-MS) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING FEBRUARY 28, 1967. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1967. Contract W-7405-eng-36. 64p. Dep. NTIS $6.25.

Declassified 29 Aug 1973.

The full power test of PHOEBUS 1B was conducted on Feb. 23, 1967. It was operated at full power for over 30 minutes. The results are discussed in some detail. PHOEBUS 1C design progress is described. PHOEBUS 2 cold flow assemblies are underway, many calculations have been made and design is proceeding. Test facility operations are described. Fabrication, testing and development of graphite fuel elements (including coatings) is reported. (LTN)

31895 (LA-3723-MS) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING MAY 31, 1967. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1967. Contract W-7405-eng-36. 72p. Dep. NTIS $6.75.

Declassified 29 Aug 1973.

The full power test of PHOEBUS-1B was run successfully on February 23, 1967. A mixmum power of 1450 MW was obtained and a gas temperature of 4400°F. More information is given on this and other tests on this reactor such as reactivity, fuel element corrosion, coatings, postmortem examination, etc. Progress and/or experiments with other reactors, critical assemblies, cold flow test equipment, test facilities, etc. is summarized. Work on fuel elements, coatings, phase studies, etc. is covered briefly. (LTN)

31896 (LAMS-2472) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING SEPTEMBER 20, 1960. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1960. Contract W-7405-eng-36. 73p. Dep. NTIS $6.75.

Declassified 28 Aug 1973.

The KIWI-A-prime reactor failed in a full power test after 308 seconds. A few elements fractured and were ejected from the nozzle. The cause has not been identified. Thermal capsules indicated that temperatures up to 4500°F were attained in some areas of the reactor and that the niobium carbide coatings prevented corrosion of the graphite. Development, fabrication or design is progressing on the KIWI-A3, KIWI-B and PHOEBUS reactors. Various computer calculations involving reactor temperature at power, temperature gradients, shielding and radiation heating have been made. (LTN)

31897 (NAA-SR-12449) ELECTRON MICROSCOPY ANALYSIS OF IRRADIATED SNAP 8 FUEL. Miller, K. J. (Atomics International Div., Canoga Park, Calif. (USA)). 20 Aug 1967. Contract AT(04-3)-701. 66p. Dep. NTIS $6.50.

Declassified 3 Mar 1975.

The irradiated fuel for this study was obtained from the SNAP 8 Experimental Reactor and the NAA 115-1 Capsule Irradiation Experiment. The fuel burnup achieved in these experiments was approximately 0.2 and 0.4 met. at. %, respectively. During the postirradiation examinations, physical measurements and metallography were performed on the fuel to determine volume changes and fuel microstructure. Metallography revealed the fuel surface features up to 500 X magnification; however, it was felt that further characterization of the fuel structure beyond that possible with optical metallography could be made through the use of an electron microscopic examination at selected fuel rod locations. Fuel samples were chosen both from regions of large volume change and excessive hydrogen loss. (10 references) (auth)

31898 (NTO-I-0301) SUPPORT OPERATIONAL REQUIREMENTS DOCUMENT FOR XECF TEST SERIES. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 13 Dec 1967. 56p. Dep. NTIS $6.00.

31899 (NTO-M-23876) SEMI-MONTHLY PROGRESS REPORT. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 3 Jul 1968. 37p. Dep. NTIS $5.00.

Research progress is reported in programs on reactor operation, engine test stand operations, product assurance, health and safety, radiochemistry, facility systems, and technical support. (JRD)

31900 (NTO-M-24504) NTO SEMI-MONTHLY PROGRESS REPORT, JUNE 15–JUNE 30, 1968. (NERVA TEST OPERATIONS, JACKASS FLATS, NEV. (USA)). 18 Jul 1968. 25p. Dep. NTIS $4.25.

Progress is reported in programs on reactor operations, engine test stand operations, health and safety, criticality, materials management, fuel element development, radiochemistry, facility systems development, and construction. (JRD)

31901 (NTO-M-24560) SEMI-MONTHLY PROGRESS REPORT, JULY 16 THROUGH JULY 31, 1968. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 16 Aug 1968. 32p. Dep. NTIS $4.75.

Activities in NERVA reactor research programs are summarized. Information is included on reactor operations, product assurance, criticality, engine test stand operation, and technical support. (JRD)

31902 (NTO-R-0124) TEST REPORT FOR SHOCK AND VIBRATION LOADS ON WEIGHTED ENGINE MOCK-UP (WEMU). Krelovich, L. E. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 11p. Dep. NTIS $4.00.

The purpose of this test was to determine the shock and vibration imposed on the XECF during transportation from E-MAD to ETS-1 and return. The records taken indicated no acceleration in excess of ½ "g" in any direction at any time. Thus, it is recommended that the system be accepted for transportation for the XECF test article when operated at a maximum speed of 5 mph on tangent trackage and a maximum speed of 2 mph while traversing all switches and curves. (auth)

31903 (NTO-T-0022) FUNDAMENTALS OF RADIATION SAFETY. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Apr 1967. 85p. Dep. NTIS $7.25.

The Fundamentals of Radiation Safety Course is designed to provide personnel with the minimum basic technical knowledge necessary for safe performance on the job, where radiation exposure may occur. This instruction manual has been prepared for those enrolled in the course and should be excluded from reading lists or periodicals as generally published. (auth)

31904 (ORNL-3489) SPACE POWER PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1963. (Oak Ridge National Lab., Tenn. (USA)). 11 Oct 1963. Contract W-7405-eng-26. 255p. Dep. NTIS $15.75.

Declassified 31 Aug 1973.

Information is presented concerning the MPRE design, reactor physics, and development tests; heat transfer and fluid flow for liquid metals; evaluation studies of materials for high-temperature applications; compatibility studies of alkali metals and structural materials; uranium nitride studies; and SNAP shielding. (DCC)

31905 (ORNL-4048) SUMMARY OF THE MPRE DESIGN AND DEVELOPMENT PROGRAM. Fraas, A. P. (Oak Ridge National Lab., Tenn. (USA)). Jun 1967. Contract W-7405-eng-26. 109p. Dep. NTIS $8.50.

Declassified 4 Sep 1973.

A comprehensive summary of the MPRE program is presented, and the reactor and system are described in some detail. The bases for devising and selecting the concept are summarized, together with its development potential. The problems confronted are outlined, and the design and test program undertaken to solve them is discussed along with the principal results of the tests. Numerous references are included to relate statements in the text to the appended list of 96 reports and papers published in the course of the MPRE program. The principal accomplishments are cited, and the status of the test work as the program was halted at the end of FY 1966 is presented, together with a summary of the remaining problems to be solved if the program were reactivated. (auth)

31906 (RN-70005) NOZZLE SKIRT EXTENSION FABRICATION AND TESTING. Technical Discussion. (Aerojet Nuclear

Systems Co., Sacramento, Calif. (USA)). 1 May 1970. 9p. Dep. NTIS $4.00.

The advantages of fabricating a nozzle skirt extension from A. G. Carb and testing it are presented. Experience is needed in fabricating the material and test results should verify the predicted erosion rates. The use of this material would simplify engine design, eliminate the need for cooling the extension and reduce engine weight. The problem of corrosion–erosion of the material in a hydrogen atmosphere was evaluated in small scale tests. (LTN)

31907 (RN-71008) PREFACE AND WORK STATEMENTS: OCTOBER 1, 1970–SEPTEMBER 30, 1972. Volume I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1971. 118p. Dep. NTIS $9.00.

The work to be done from Oct. 1, 1970 through Sept. 30, 1972 is described on a project by project basis to ensure agreement between the company and the government as to what is involved. (LTN)

31908 (RN-A-0007(Vol.3)) BUDGET ESTIMATES. 1968 NERVA Development Program. Volume III. NASA Schedules 189 and Exhibits E, F, and G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Apr 1966. 289p. Dep. NTIS $17.50.

Budget narratives and estimated costs are given in summary and by tasks for CY 1966, 1967 and 1968. (LTN)

31909 (RN-A-71007(Final)) LONG-LIFE, SPACE-MAINTAINABLE NUCLEAR STAGE REGULATORS AND SHUTOFF VALVES. Final Report. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1972. 249p. Dep. NTIS $15.50.

The overall objective of the program was, first, to generate sketches of the most promising concepts of nuclear stage regulators and shutoff valves with characteristics suitable for being space maintainable and capable of operation under the conditions set forth. The six most promising valve, regulator and remote coupling concepts were then subjected to further investigation. The concepts generated took into consideration the problems associated with the selection of materials and design configurations (including tolerances) to ensure that the designs are capable of meeting the performance requirements under the specified environmental conditions. Problems associated with leakage, wear and operating life, contamination, storage life, temperature, pressure, radiation, and vibration environments, and remote in-space maintenance were solved for each concept. (auth)

31910 (RN-DR-0103(Suppl.)(Vol.5)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Graphic/Numeric Cost Displays. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 129p. Dep. NTIS $9.50.

NRO Fiscal Control has prepared graphs for each task utilizing computer planning techniques to facilitate evaluation of Aerojet's Long Range Plan (1968-1975) for development of the NERVA engine. Data identified as RN-DR-0079, annotated (N), represents the Long Range Plan submitted last fall adjusted to the task structure, labor and overhead rates, material escalation, and man hours per year used in RN-DR-0103. Some assumptions were required for this computation. Incremental costs at the sub-subtasks level were plotted with the cumulative data presented in tabular form at the bottom of each plot. RN-DR-0103 data is annotated (C). (auth)

31911 (RN-DR-0177A(Vol.1)) DESIGN REQUIREMENT SHEETS FOR THE PROPELLANT-FEED SUBSYSTEM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 174p. Dep. NTIS $11.75.

Design requirement sheets are provided for components of the Propellant Feed System of the 75K, Full Flow NERVA reactor as follows: Propellant Feed System (EC 90218); Propellant Shutoff Valve and Actuator (EC-90117); and the Turbine Block Valve and Actuator (EC-90121). (LTN)

31912 (RN-DR-0177A(Vol.2)) DESIGN REQUIREMENT SHEETS FOR THE PROPELLANT-FEED SUBSYSTEM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 123p. Dep. NTIS $9.25.

Design requirement sheets are provided for components of the Propellant Feed System of the 75K, Full Flow NERVA engine as follows: Bypass Control Valve and Actuator (EC-90122); and Turbopump Assembly (EC-90149). (LTN)

31913 (RN-DR-0177A(Vol.4)) NERVA DESIGN REQUIREMENTS SHEETS. Volume IV. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 225p. Dep. NTIS $14.25.

Draft design requirement sheets for various parts of the 75K, Full Flow engine were accumulated in this notebook as they were completed and/or revised as follows: Coolant Supply Control Valve and Actuator (EC-90258), Structural Support Block Valve and Actuator (EC-90261), Stage Tank Pressurization Line and Check Valve (DS-90263), and the Engine Purge Unit (DS-90264). (LTN)

31914 (RN-DR-0177A(Vol.5)) DESIGN REQUIREMENTS SHEETS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1970. 126p. Dep. NTIS $9.50.

Design criteria and functional performance requirements are provided for components of the 75 K, Full Flow NERVA engine as follows: Cooldown Shutoff Valve and Actuator (EC-90276); Turbine Discharge Block Valve and Actuator (EC-90281); and Turbine Throttle Valve and Actuator (EC-90283). (LTN)

31915 (RN-DR-0177A(Vol.6)) DESIGN REQUIREMENTS SHEETS: COOLDOWN LINES, PROPELLANT INLET LINE, PUMP DISCHARGE LINE, AND STRUCTURAL SUPPORT COOLANT LINES. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1970. 206p. Dep. NTIS $13.50.

Design requirement sheets are provided for lines on the 75K, Full Flow NERVA engine as follows: Cooldown Lines (EC-90284); Propellant Inlet Line (DS-90284); Pump Discharge Line (DS-90284); and the Structural Support Coolant Lines (DS-90265). (LTN)

31916 (RN-DR-0183A) DESIGN REQUIREMENT SHEETS FOR THE GIMBAL-ASSEMBLY SUBSYSTEM, EC 90244. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 109p. Dep. NTIS $8.50.

Design requirement sheets are provided for components of the 75K, Full Flow NERVA reactor as follows: Gimbal Assembly Subsystem (EC-90244); and the Gimbal Actuator (DS-90251). (LTN)

31917 (RN-DR-0184A) DESIGN REQUIREMENT SHEETS FOR THE PRESSURE-VESSEL-AND-CLOSURE SUBSYSTEM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 146p. Dep. NTIS $10.50.

Design Requirement Sheets for various parts of the 75K, Full Flow NERVA engine were accumulated in this notebook as they were completed or revised as follows: Pressure Vessel and Closure Subsystem (EC-90154), External Shield Subsystem (EC-90243) and the Destruct Subsystem (EC-90242). (LTN)

31918 (RN-FOP-0005) NERVA PROGRAM. Operating Procedure: Cryogenic System Test Cell A. (NERVA Test Operations, Mercury, Nev. (USA)). 15 Nov 1963. 58p. Dep. NTIS $6.00.

The instructions are typical for the operation of Test Cell A when testing the KIWI-B4A reactor; testing of the NRX reactor will require modification of the procedures. (DLC)

31919 (RN-FOP-0015) NERVA PROGRAM. Test Cell A, Dewar Deluge System. (NERVA Test Operations, Mercury, Nev. (USA)). 15 Jun 1963. 19p. Dep. NTIS $4.00.

Procedures for operation of KIWI-B4A test cell dewar deluge system are presented. This system is used when speed is required in extinguishing or controlling fast spreading fires. (JRD)

31920 (RN-NC-0006) ADVANCED NERVA (WITH PHOEBUS AFTERHEATER). (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1967. 28p. Dep. NTIS $4.50.

In the afterheater reactor, a fuel material that withstands high temperature better than graphite is added to the aft end of a graphite section to permit a higher propellant exit temperature. The concept offers a method of achieving a specific impulse higher than that attainable with graphite fuel. This report utilizes the core designs discussed in References given and describes an engine concept capable of obtaining maximum performance from an exhaust gas at a temperature of 6000°R. The optimization study traded highest performance in I_{sp} obtainable against 300 lb of stage weight for each second of impulse achieved, resulting in an engine which has an I_{sp} of 1026 sec, weighs 34,600 lb, and has a thrust of 147,000 lb. The multiple-nozzle concept is favored because it makes use of small refractory nozzles in the high-heat-flux region and has the potential of operating successfully at temperatures in the range of 6000°R, without the adverse effects on performance of large heat losses due to regenerative cooling or dilution of the exhaust stream by film or transpiration cooling. The bleed port and nozzle skirt for this engine required redesign. A U-tube port was chosen to reduce the high surface temperatures on the walls. The skirt will be fabricated of molybdenum and will be radiation-cooled. The turbopump assembly consists of a slow-speed inducer and a high-speed main-stage centrifugal pump. A comparative study of the use of NERVA and of the Advanced NERVA for a manned Mars 1982 stopover mission indicates the feasibility of eliminating three Saturn V launches if the Advanced NERVA is available from the earth-orbit position. Cost savings are estimated to be $500 million per mission. (auth)

31921 (RN-NC-0008) EFFECT OF A 200-MW NUCLEAR-POWERED STAGE ON THE COST EFFECTIVENESS OF SEVERAL LAUNCH VEHICLES FOR UNMANNED PLANETARY MISSIONS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1966. 30p. Dep. NTIS $4.50.

The performance and cost of a 10,000-lb thrust solid-core nuclear engine and stage, based on the Los Alamos Scientific Laboratory 200 MW reactor concept, are determined for exit from a 100 nautical-mile circular earth orbit over a range of hyperbolic excess velocities of 0 to 14 km/sec. The Saturn S-IB, uprated S-IB (MLV-S-IB-11), and ¾- and full-size 260-inch boosters are used as earth-launch vehicles. The performance comparisons of various propulsion mixes presented in this study identify the outstanding low-cost performance of a small nuclear engine when applied to unmanned missions to the five principal planets. (auth)

31922 (RN-PA-0021) REVIEW OF NERVA RADIATION AND SHIELDING STUDIES. Warman, E. A.; Lindstrom, D. G. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 43p. Dep. NTIS $5.25.

Slides giving radiation doses around NERVA under various conditions and a description of the shielding have been documented in reference to a few proposed space missions. (LTN)

31923 (RN-PA-0026(Vol.1)) MATERIAL PRESENTED BY AEROJET TO SNPO-C ON COMPLETION OF TASKS III AND IV OF SHIELDING TRADE STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 22 May 1969. 115p. Dep. NTIS $8.75.

Detailed and complex results of a trade study of various shielding arrangements were presented at a meeting and the slides are documented here. For the same degree of shielding, various designs differed little in weight. (LTN)

31924 (RN-PA-0029) RADIATION AND SHIELDING ANALYSES OF PROPELLANT TANKS AND PAYLOADS. Presentation at SNPO-Cleveland, July 16 and 17, 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 74p. Dep. NTIS $6.75.

Shielding calculations by the point kernel and Monte Carlo methods are compared in the application of calculating the shielding produced by the propellant tank (two designs) and payload. Agreement was excellent off axis, but point kernel results were overpredictions on axis. Crew doses less than 10 Rem are calculated. (LTN)

31925 (RN-PD-0009(Encl. 1)) REVISED CONTRACT YEAR 1964 WORK STATEMENTS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Oct 1963. 209p. Dep. NTIS $13.50.

Work to be performed in developing the NERVA nuclear rocket engine is specified. (JWR)

31926 (RN-Q-10-37) QUARTERLY PROGRESS REPORT NO. 37 FOR FIRST QUARTER, CY 1966 COVERING THE PERIOD OF OCTOBER, NOVEMBER, AND DECEMBER 1965. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1966. 413p. Dep. NTIS $23.75.

The NRX/EST test car was plugged into the test cell and all checkouts performed. Using the NRX/EST engine, reactor initial criticality was achieved and four cold flow tests were conducted. The turbine did not rotate during these four tests as a result of the formation of ice in the turbine bearings or turbine housing due to the lack of adequate purge gas flow. Corrective steps were taken, and testing is scheduled to be resumed on 6 January 1966. The objectives of CFDTS testing were achieved with the completion of 25 tests during this quarter. Testing showed that bootstrapping occurred even with an NPSP bordering on zero, thus, indicating that the required propellant tank pressure in the flight engine will be governed by full power NPSP rather than by start-up conditions. Testing also showed that dry pump starts were feasible. The NRX, EST, XE, and the NERVA designs were reviewed for potential radiation effects problems, and a program plan was outlined to evaluate these problems. Effort was expended on nuclear subsystems integration for the XE-1 engine, NRX/EST support, NERVA design support, technical liaison and coordination. The more significant specific accomplishments were the revision and updating of XE-1 Reactor Specification (AGC 90017) and resolution of problems concerning engine ionization chamber location. Support and test facility developments are described. (auth)

31927 (RN-Q-0037) RELIABILITY AND QUALITY ASSURANCE SUPPLEMENT NO. 37A LETTER COVERING THE PERIOD OF OCTOBER, NOVEMBER, DECEMBER, 1965. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1966. 39p. Dep. NTIS $5.00.

Ultrasonic and nondestructive testing of valves, nozzles, brazed joints, etc. has continued. Pressure vessels, turbopumps, etc. are being tested. A number of other leak and/or failure problems are under investigation. (LTN)

31928 (RN-S-0171(Vol. 1)) NUCLEAR ENGINE ANALYSIS PROGRAM. Volume I. Technical Discussion and Program Nomenclature. CoNine, R. D. (Aerojet-General Corp., Azusa, Calif. (USA)). Dec 1964. 118p. Dep. NTIS $9.00.

The Nuclear Engine Analysis Program is an IBM 7094 digital computer program which simulates the steady-state operation of the NERVA hot-bleed engine over the full operational range of chamber pressures and temperatures. This program computes the energy balances for all engine components and for the entire engine, as required to satisfy the demanded chamber pressure and temperature. The program output consists of temperatures, pressures, and flow rates throughout the system. In addition, program output such as the turbine inlet temperature, turbine flow rate, hot-bleed flow rate, diluent flow rate, turbopump speed, pump specific speed, turbine power control valve position, nuclear power, engine thrust and specific impulse is obtained. The program is presently in production status and is used extensively for steady-state analyses of the NERVA engine systems. (auth)

31929 (RN-S-0400(Ph. 3)) XE TEST SPECIFICATION. Phase III. Post-Test Sections. Section II.E. Post-Flow Test, Disassembly and Examination Specification. Section III.K. NES Duct Fission Product Deposition Survey. Final Issue. (Aerojet-General Corp., Sacramento, Calif. (USA)). 8 Aug 1969. 28p. Dep. NTIS $4.50.

Plans are developed for the disassembly of the engine in the E-MAD complex, and a cursory examination of the components, with the proviso that failed parts will be examined more closely. A detailed checkout of the instrumentation, valves and control drum actuators is recommended. A radiation survey is specified. (LTN)

31930 (RN-S-0418(Bk. 1)(Suppl. 5)(Sec. 9)(Ph. 3)) BOOK I. XE-P Test Predictions. Supplement 5 to Section 9. Issuance of Phase III, Run 6, Run 7, Run 10, Run 11, Run 12, and Run 13. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Jul 1969. 33p. Dep. NTIS $4.75.

31931 (RN-S-0418(Bk. 1)(Suppl. 6)(Sec. 9)(Ph. 3)) BOOK I. XE-P Test Predictions. Supplement 6 to Section 9. Issuance of Phase III, Run 11, and Run 13. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Jul 1969. 29p. Dep. NTIS $4.50.

31932 (RN-S-0418(Bk. 1)(Suppl. 7)(Sec. 9)(Ph. 3)) XE-P TEST PREDICTIONS. Book I. Supplement 7 to Section 9. Issuance of Phase III, Runs 14, 15, 17, 18, 19, 20, and 21. (Aerojet-General Corp., Sacramento, Calif. (USA)). 24 Jul 1969. 50p. Dep. NTIS $5.50.

31933 (RN-S-0418(Bk.1)(Suppl.9)(Sec.9)(Ph.3)) XE-P TEST PREDICTIONS. Book I. Supplement 9 to Section 9. Issuance of Phase III, Runs 28, 29, and 30. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 Aug 1969. 52p. Dep. NTIS $5.75.

31934 (RN-S-0469(Rev.6)) E-1 COMMON ANALOG MODEL, S307-CAM08-W111. Revision 6. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Nov 1970. 64p. Dep. NTIS $6.25.

31935 (RN-S-0519) WELDABILITY EVALUATION OF THICK SECTIONS OF HASTELLOY X WITH VARYING ALUMINUM CONTENT. Fletcher, C. W. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jul 1969. 15p. Dep. NTIS $4.00.

Hot cracking and poor wettability of the molten weld metal presented problems in welding the thick sections of the Hastelloy X Phoebus 2 nozzle. A program was conducted to evaluate the effect of varying percentages of aluminum on the weldability of Hastelloy X. The results indicate that lowering the aluminum content of Hastelloy X improves weldability. Utilization of the low-aluminum Hastelloy X material for the NERVA nozzle should result in improved weld quality and lower welding costs. (auth)

31936 (RN-TD-0002(Rev.1)) XE-1 ALUMINUM PRESSURE VESSEL, ACCEPTANCE PROCEDURE. Cornell, A. D. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 3 Aug 1966. 19p. Dep. NTIS $4.00.

31937 (RN-TD-0002(Rev. B)) REVISION B. ACCEPTANCE PROCEDURE XE-1 ALUMINUM PRESSURE VESSEL. Cornell, A. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Apr 1966. 18p. Dep. NTIS $4.00.

31938 (RN-TD-0004(Rev. A)) REVISION A. Acceptance Procedure NRX-A6 Aluminum Pressure Vessel. Locke, R. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 14 Jul 1966. 18p. Dep. NTIS $4.00.

The objective of the hydrostatic test is to demonstrate that the pressure vessel is capable of withstanding an ambient proof pressure of 740 psig in accordance with the following acceptance criteria: (a) the pressure vessel components, forward closure assembly and cylinder shall not rupture, (b) all significant interface dimensions shall remain within drawing specification. Item (b) measurements are presented. A seal leakage test shall be performed to check the leak tightness of the eight port adapters, twelve guide tube welds and one plugged port. (auth)

31939 (RN-TD-0005) ACCEPTANCE PROCEDURE FOR THE XCEF UPPER THRUST STRUCTURE, P/N 1115459-29. Thomas, R. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 2 Jun 1966. 12p. Dep. NTIS $4.00.

Testing is performed to demonstrate structural integrity when subjected to XE-1 loads. The proof loads are specified. The acceptance criteria are: (1) There shall be no detrimental buckling. (2) All post-test dimensions shown shall either agree with the pre-test reading within the accuracy of the inspection equipment used or within the tolerances specified. Responsibilities are defined. (auth)

31940 (RN-TD-0007) XE PRIME ENGINE END ITEM ACCEPTANCE TEST PROCEDURES, THRUST STRUCTURES. Jessen, P. J. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Aug 1966. 26p. Dep. NTIS $4.50.

Acceptance criteria are presented for the structural integrity tests on the XE-Prime upper and lower thrust structure when subjected to proof loads. (JWR)

31941 (RN-TM-0286) EFFECT OF NRX/EST FLOW SHUTDOWN ON NOZZLE AND BLEED PORT. Snyder, C. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 2 Dec 1965. 18p. Dep. NTIS $4.00.

The possibility of nozzle overheating (particularly at the throat) due to a flow shutdown was investigated by analog methods. Conditions which will prevent overheating are specified. (LTN)

31942 (RN-TM-0302) NRX/EST DILUENT CONTROL VALVE SHAFT RETAINING RING DISLODGEMENT INVESTIGATION. Mathews, J. P. (Aerojet-General Corp., Sacramento, Calif. (USA)). 11 Jan 1966. 10p. Dep. NTIS $4.00.

A shaft retaining ring of the four inch butterfly valve was found to be dislodged from the valve body groove following liquid hydrogen flow tests conducted for evaluation of the valve for diluent control usage in the NRX/EST engine system. The cause of the dislodgement was investigated. The dislodgement was caused by improper installation of the ring into the valve assembly. (auth)

31943 (RN-TM-0315) X-ENGINE LOWER THRUST STRUCTURE MATERIALS EVALUATION. Jessen, P. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 May 1966. 18p. Dep. NTIS $4.00.

A materials evaluation program was conducted to determine the optimum material for the X-engine lower thrust structure when operated in Engine Test Stand One (ETS-1) for a 1200 second full power run. Several materials including aluminum, nickel, and titanium alloys were evaluated. Consideration was given to strength, heat transfer, radiation effects and ease of fabrication. Based on this analysis annealed titanium alloy Ti-6Al-4V was selected. (auth)

31944 (RN-TM-0345) THERMAL ANALYSIS IN SUPPORT OF RADIATION EFFECTS AND THERMAL CONDUCTIVITY TEST PROGRAM. Thomas, E. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Apr 1966. 19p. Dep. NTIS $4.00.

Thermal analyses were performed to provide thermal requirements for thermal conductivity tests of A-286 steel, A-110-AT titanium, and 6061-T6 and 7039 aluminum. (auth)

31945 (RN-TM-0346) TEST PLAN FOR THE X-ENGINE REMOTE ASSEMBLY DESIGN AID (RADA). Shrade, F. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Apr 1966. 27p. Dep. NTIS $4.50.

The Test Plan for the X-Engine Remote Assembly Design Aid (RADA) describes the test objectives, the hardware to be tested, and the ground support equipment to be used during testing with the RADA engine assembly. The test program will be conducted to develop the interface hardware and the procedures necessary for the remote replacement of the X-Engine Upper Thrust Structure Module (UTSM). During the RADA development testing, the Remote Handling Facilities and GSF will be appraised with respect to their capability to replace the UTSM remotely. The tests will be performed at Sacramento in Building 2002, Engine Assembly Area, and in the hot bay of the E-MAD Building at NTO, during 1966. (auth)

31946 (RN-TM-0599) MINIMUM BEND RADIUS RECOMMENDATIONS FOR PNEUMATIC INSTRUMENTATION LINES. Samuelson, R. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 74p. Dep. NTIS $6.75.

Nearly all commercially available seamless tubing stock can be bent with conventional hand tools without compromising the structural integrity of the tube or producing excessive signal distortion. This results from the fact that most commercial tubing is fabricated using annealed, ductile tubing possessing moderately thick walls while most hand benders typically provide a centerline bend radius of three or more tube diameters. There are circumstances, however, when conventional materials and techniques cannot be applied. When acquiring tubing for space flight applications, it is often necessary to adopt "weight-saving" thin wall tubing whose use will increase the probability of encountering excessive outer wall thinning and inner wall buckling. Service conditions requiring the adoption of less ductile materials will enhance outer wall fracturing. Mechanical obstructions may require the adoption of an unusually small bend radius which will increase signal distortion, enhance outer wall fracturing, promote excessive outer wall thinning, or produce inner wall buckling. These and other abnormal circumstances are the basis for a critical evaluation of the bend section to be sure that minimum allowed bend radius criteria have not been exceeded. Theoretical equations have been derived that may be used to provide minimum bend radius criteria. For the most part, the theoretical derivations are enclosed as appendices with only the results being presented in the technical discussion. This was done to simplify the text and to emphasize those equations which are most meaningful. (auth)

31947 (RN-TP-0002(Amend.1)) HEAT TRANSFER MARGIN TEST FOR XE TYPE NOZZLE. Amendment No. 1. Wright, R. B. (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 Sep 1966. 4p. Dep. NTIS $4.00.

After one successful test on the heat transfer margin series at 675 psia chamber pressure, three additional attempts to test at 750 psia chamber pressure all resulted in premature shutdowns due to combustion instability. To help prevent combustion instability, the KAMT-51-1 injector pattern which gave satisfactory results at 650 psi chamber pressure and mixture ratios from 3.58 to 8.28 will be used. The chamber pressure will be limited to 800 psia, and the start transient will be modified to keep the mixture ratio higher during the chamber pressure rise ramp. (auth)

31948 (RN-TP-0003) ACCEPTANCE PROCEDURE: NOZZLE, U-TUBE, NERVA NRX-A5. Watkins, J. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Feb 1966. 14p. Dep. NTIS $4.00.

Static proof, leak, water flow, and tube cross-sectional area measurements are defined for demonstrating that the nozzle has been correctly fabricated and is capable of withstanding, without damage, the loads imposed during the NRX-A5 test program. Radiographic examination is specified. (LTN)

31949 (RP-MR-0009) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD OF 1 MARCH–31 MARCH 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1966. 59p. Dep. NTIS $6.00.

Nozzle development continued, as did the determination of the mechanical properties of Hastelloy X. Overpressurization of a test system with hydrogen resulted due to a lack of feedback pressure signal to a control valve. This overpressurization resulted in a burst diaphragm, which was followed by an explosion. (LTN)

31950 (RP-MR-0010) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD OF 1 APRIL–30 APRIL 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1966. 72p. Dep. NTIS $6.75.

Work was devoted mainly to nozzle development and fabrication and to a determination of the mechanical properties of Hastelloy X. (LTN)

31951 (RP-MR-0018) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD 1 APRIL–30 APRIL 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 204p. Dep. NTIS $13.25.

Includes report RP-TM-0014.

31952 (RP-QR-0003) PHOEBUS-2 QUARTERLY REPORT FOR THE PERIOD OF 1 DECEMBER–28 FEBRUARY 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1966. 118p. Dep. NTIS $9.00.

Work continued on heat transfer measurements, nozzle development and the measurement of the mechanical properties of Hastelloy X. Test facility progress is reviewed. Many other details are mentioned. (LTN)

31953 (RP-QR-0004) PHOEBUS-2 QUARTERLY REPORT FOR THE PERIOD OF 1 MARCH 1966–31 MAY 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1966. 124p. Dep. NTIS $9.25.

Most of the work was related to (1) nozzles (design, fabrication, welding, brazing, stress analysis, etc.), or to (2) measurements of the mechanical properties of Hastelloy X. Some heat transfer results were reported. (LTN)

31954 (RP-TM-0002) SCALE BURN POND TEST PROGRAM PRESENTATION OF GH_2 DISPOSAL SYSTEM. Phoebus-2. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1966. 43p. Dep. NTIS $5.25.

31955 (RP-TM-0011) PHOEBUS-2 NOZZLE HYDROSTATIC STRUCTURAL TEST REPORT. Pickering, J. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1967. 83p. Dep. NTIS $7.25.

The hydrostatic pressure test of the Phoebus-2 pressure vessel and nozzle was conducted in two parts: Phase 1, a hydrostatic structural test to simulate the loading condition at nuclear steady state (excluding temperature effects); and Phase 2, hydrostatic proof test in which the test assembly was subjected to 1.2 times the loads achieved in the Phase 1 test (excluding external thrust load). Test objectives were: To verify the structural analysis of the Phoebus-2 pressure vessel–nozzle interface; to ensure that structural compatibility exists between the pressure vessel and nozzle; to prove the structural integrity of the design; and to determine the operational limitations of the test assembly. Phase 1 data were incomplete and are not used. Data from two tests under the Phase 2 loading condition were used for verification of the structural analysis. The close agreement between Phase 2 test results and analytical predictions indicate the methods and assumptions made in the analytical approach were correct. The test assembly was able to withstand proof pressure without material yielding. All test objectives for the nozzle pressure test were achieved. (auth)

31956 (RP-TM-0012) DESIGN REPORT OF PHOEBUS-2 MULTI-ORIFICE INJECTOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1967. 176p. Dep. NTIS $12.00.

The design and fabrication of the Phoebus-2 multi-orifice injector as it evolved from the basic NERVA design to one which would meet the higher Phoebus-2 flow rates and chamber pressure is described. Differences between the two injectors are listed and a step-by-step fabrication process for injector components is described. Supporting documents are provided in the areas of stress analysis, heat-transfer analysis, combustion stability, and conduction heat-transfer analysis. A basic parts list for the injector is also included. (auth)

31957 (RP-TM-0018(Vol.1)) STRESS ANALYSIS OF THE PHOEBUS-2 NOZZLE TEST ASSEMBLY. Volume I. Pickering, J. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1967. 257p. Dep. NTIS $16.00.

An analysis was made to determine the maximum stress locations in the structure and the relative deflections of the mating parts of the sealed joints using the composite structure as the mathematical model. The operating condition analyzed is 750 psia chamber-pressure chemical simulation with a maximum duration of 20 seconds. Other conditions studied were: assembly loads due to the pre-loaded condition; the pressure-only case which would simulate a start-up condition; the actual operating condition; and a temperature-only case which would be indicative of a shutdown condition. Each component is considered separately: i.e., each component section has its introduction, mathematical model, and influence coefficients, or deformation equations describing the component geometry and action under unit loading. The behavior of each component of the test assembly is written in equation form and these are solved simultaneously for the redundant loads at the shell and ring interfaces. These loads are used as boundary conditions for the component mathematical model in the PETS computer program and solved for the stresses under the condition being analyzed. This volume contains only the results of the simultaneous equation solution and the derivation of the formulas used. Volume II utilizes the results of this report by using the forces, rotations and deflections for the matrix solution as boundary conditions on the PETS mathematical model and calculates the stresses, which are reported with the minimum margin of safety of each component. (auth)

31958 (RP-TM-0018(Vol.2)) STRESS ANALYSIS OF THE PHOEBUS-2 NOZZLE TEST ASSEMBLY. Volume II. Pickering, J. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1967. 251p. Dep. NTIS $15.75.

The stress analysis of the Phoebus-2 nozzle test assembly is presented. The analysis includes the effects of both internal pressure and thermally induced loads. The analysis was carried out with the aid of the PETS Digital Computer Program. Interface loads, rotations and deflections are described under various loading conditions in Volume I, while this volume contains the stresses as a result of these loads and deflections. (auth)

31959 (RP-TR-0003) PHOEBUS-2 NOZZLE RELIABILITY PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1965. 41p. Dep. NTIS $5.25.

The company's planned organization, divisional responsibilities, and methods to ensure reliability and quality assurance in the Phoebus-2 nozzle is described. (LTN)

31960 (RP-TR-0005) PHOEBUS-2 NOZZLE: PROOF TEST METHOD, CHEMICAL SIMULATION TEST PLAN. Kawashige, C. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1965. 36p. Dep. NTIS $5.00.

This test plan describes the proof test methods in which chemical test firings will be used to demonstrate the capability of the nozzle to operate at reactor design conditions and also describes the chemical test firings required to develop injectors, nozzle-to-injector adapters, and other associated test hardware. (auth)

31961 (RP-TR-0005A(Rev.)) PHOEBUS-2 PROOF TEST METHOD, CHEMICAL SIMULATION TEST PLAN (REVISED). Kawashige, C. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1966. 35p. Dep. NTIS $4.75.

The chemical tests to be conducted during the Phoebus-2 Nozzle Program to meet the requirements specified by Contract SNPC-35, the Phoebus-2 Program Plan, and the Phoebus-2 Nozzle Reliability and Quality Assurance Program Plans are described. Chemical testing will be conducted using LO_2/LH_2 to provide hot gases to the nozzle chamber to simulate the nuclear reactor firing. Successful operation of the nozzle under chemical test conditions will confirm that duplicate nozzles are qualified for use with the Phoebus-2 reactor. Three test series are planned: Chemical simulation component development testing; Phoebus-2 nozzle proof testing; and Phoebus-2 nozzle operating limit determination testing. The chemical simulation component development testing series will be conducted with the film-cooled nozzle, the nozzle-to-injector adapter, the injector, and applicable propellant lines. The proof test and operating limit determination test series will use the Phoebus-2 nozzle and applicable lines in place of the film-cooled nozzle. (auth)

31962 (RP-TR-0006) PHOEBUS-2 NOZZLE: COMPONENTS AND TEST ASSEMBLY INSPECTION AND TEST PLAN. Komjathy, S. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1965. 15p. Dep. NTIS $4.00.

This plan shows the major fabrication steps of forming, welding, and stress relieving and corresponding inspection points—material release, nondestructive tests, dimensional checks, hydrostatic tests, leak tests, shop acceptance test plan, installation, and acceptance test plan—for the major parts, subassemblies, and complete assembly. (auth)

31963 (TCR-9616-017) HEAT TRANSFER ANALYSES ON NUCLEAR HYBRID THRUST CHAMBER. Part I. Hester, J. N. (Aerojet-General Corp., Sacramento, Calif. (USA)). 21 Nov 1962. 18p. Dep. NTIS $4.00.

An analysis of the heat transfer characteristics of the nuclear hybrid thrust chamber was undertaken to determine the behavior of the nozzle jacket and the nozzle-to-pressure vessel flange during operation in a nuclear environment. Two analog type computers—an electronic differential analyzer and a passive element thermal analyzer—were used for the determinations. Wall temperature distributions are presented for the nuclear environment conditions. This temperature data indicate that the thrust chamber will not experience heat transfer difficulties during its exposure to nuclear radiation. (auth)

31964 (TCR-9626-006) SUMMARY REPORT ON FABRICATION OF NUCLEAR THRUST CHAMBER TEST ASSEMBLY COMPONENTS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 Mar 1963. 59p. Dep. NTIS $6.00.

A history of the fabrication steps and difficulties experienced on nozzles being processed at Aerojet-General, Sacramento facility is reported. It is noteworthy that most of the discrepancies were encountered on "first of the kind" nozzles and that benefits gained have become evident in the fabrication of subsequent units. Regarding the most crucial problem connected with the quality of aluminum cast jackets–a task force has been formed. Precautions to minimize denting of coolant tubes are listed and, since they have not been completely adequate, are being upgraded by closer surveillance by supervisory and quality control personnel. (auth)

31965 (TIC/SNA-1065) NERVA SPECIFICATIONS. Book 5. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 105p. Dep. NTIS $8.25.

Specification requirements are provided for components of the 75K, Full Flow NERVA engine as follows: Structural Support Coolant Lines (DS-90265), Turbine Bypass Line (DS-90266), Stage Tank Pressurization Line and Check Valve (DS-90263), Cooldown Lines (DS-90262), Propellant Inlet Line (DS-90253), Turbine

Discharge Line (DS-90125), Pump Discharge Line (DS-90135) and the Turbine Inlet Line (DS-90124). (LTN)

31966 (TIC/SNA-1067) NERVA DETAIL SPECIFICATION. Part 1. Performance/Design and Qualification Requirements for Valves, Actuators and Other Components. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 17 Jul 1970. 197p. Dep. NTIS $13.00.

Detailed specifications are provided for components of the 75K, Full Flow NERVA Engine as follows: Turbine Throttle Valve and Actuator (EC-90283), Stage Tank Pressurization Line and Check Valve (DS-90263), Engine Purge Unit (DS-90264), and Propellant Lines (DS-90284). These are parts of the Propellant Feed Subsystem (EC-90218). (LTN)

31967 (TID/SNA-148) ENGINE/COMPONENT DESIGN STATUS REVIEW. Phase I. Four Ongoing Components. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 6 Apr 1971. 320p. Dep. NTIS $19.00.

Slides presented at a design review meeting on nozzle extensions, turbopumps, valves and actuators are documented. Many development and test results were presented. (LTN)

31968 (TID/SNA-150) STATEMENT OF WORK COVERING THE PERIOD OCTOBER 1, 1970–SEPTEMBER 30, 1972. Supplement A71/72C TO Appendix B. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Jun 1971. 145p. Dep. NTIS $10.25.

Work programs are reviewed in detail on a project by project basis to establish a basis for agreement between the company and the government as to what is expected to be accomplished during the current year. (LTN)

31969 (TID/SNA-152) NERVA OPERATING PLAN, m001-N0P06-W231f3. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 41p. Dep. NTIS $5.25.

The NERVA Operating Plan delineates the ANSC internal management system relative to the execution of the present NERVA Program two-year contract period. This plan is divided into four sections: A brief narrative description of the duties and responsibilities of each ANSC organization element, down through the section level; a matrix which identifies the organizational responsibilities relative to the preparation, support and approval of the documents called for in the present negotiated work statement; a listing of program directives, procedures and policy documents necessary to execute the NERVA Program; and the current ANSC organization chart. (auth)

31970 (TID/SNA-168) ANALYSIS OF THE TURBINE INLET LINE RESONANCE SURVEY AT 168°–30′ (SERIES III) OF THE VIBRATION SURVEY OF XECF IN ETS-1. Rosser, R. C.; Tow, D.; Jellison, J. E. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Apr 1968. 135p. Dep. NTIS $9.75.

A complete analysis of the turbine inlet line resonance survey test, test results, supporting dynamic analyses, and conclusions is presented. The conclusions are quite detailed and relevant only to that equipment, but are a reasonable example of what can be accomplished with these techniques. (LTN)

31971 (TID/SNA-178(Vol.1)) REQUIREMENT ALLOCATION SHEETS. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 437p. Dep. NTIS $25.00.

31972 (TID/SNA-318) CERTIFICATION METHODOLOGY ASSURES COMPLETE AND OPERATIONAL COMPUTER PROGRAMS, m001-CSC05-W236a2. Ledbetter, D. L.; Gilchrist, E. J.; Moirano, L. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 215p. Dep. NTIS $13.75.

Certification of computer programs for the NERVA program of Aerojet Nuclear Systems Company (ANSC) is a process whereby all computer codes are reviewed prior to dissemination outside ANSC. The purpose of this review is to define the exact computer system configuration under which the code will run; the complete library of subroutines, both standard and nonstandard, required in support of the code; and supporting documentation for the code in such forms as compilation listings, operating considerations, and user's manual. Finally, a letter of certification is prepared and issued after the total source program deck, with a test case, has compiled and executed successfully. (auth)

31973 (TID/SNA-320) REFERENCE MISSION DATA BOOK FOR NERVA DESIGN, S114-CP090290-F1. Volume II. Detailed Tabular Computer Data. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 529p. Dep. NTIS $29.50.

The Nuclear Engine for Rocket Vehicle Application–NERVA–operating requirements and supporting data for reference missions, reusable vehicles, and trajectory analyses are presented. Three reference missions, based on the generalized mission descriptions in the NPRD, call for a reusable nuclear engine to be: Employed for the transfer of men and/or materials from earth orbit to lunar orbit and return, or used for injection staging of a deep-space probe and return of the stage to earth orbit. The primary objective has been to define the NERVA engine requirements necessary to perform the flight operations required for the reference missions and to provide a base case for determining engine design solutions resulting in payloads consistent with reliability, safety, and engine performance requirements. This volume contains the detailed tabular data. (auth)

31974 (TID/SNA-352) NERVA DATA AND DOCUMENT MANAGEMENT CONTROL PLAN, C100-SS-09205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 64p. Dep. NTIS $6.25.

31975 (TID/SNA-368) PRELIMINARY NERVA TEST PROGRAM PLAN, T101-CP090290-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 59p. Dep. NTIS $6.00.

The test logic, interrelationships, constraints, general requirement, and test philosophy for the NERVA engine are described. Documentation and report requirements for testing are also presented. (JWR)

31976 (TID/SNA-373) NERVA NUCLEAR PROPULSION PRESENTATION. Los Alamos Scientific Laboratory. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Jul 1970. 171p. Dep. NTIS $11.75.

Information is presented on the NERVA engine, engine subsystems, controls, ground test experience, and propulsion/electric power. (JWR)

31977 (TID/SNA-375) NERVA CONTAMINATION AND CORROSION CONTROL PLAN, S021-CP090290-F1. Lamvermeyer, D. J.; Murchison, M. L. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 88p. Dep. NTIS $7.50.

Criteria for preventing, controlling, identifying, and treating various forms of contamination and corrosion in the NERVA engine system and associated ground-support equipment are presented. (JWR)

31978 (TID/SNA-378) OVAL VERSUS U-TUBE NERVA NOZZLE DIVERGENT SECTION DESIGN STUDY, s054-DS301-W141-36. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 91p. Dep. NTIS $7.25.

The design approaches undertaken and the results obtained for the selection of a design concept for the NERVA nozzle divergent section are described. The two design approaches that were proposed (a U-tube concept and an oval-tube concept) were compared against the most significant characteristics of the nozzle (i.e., transient dynamic loads imposed upon nozzle assembly as a result of flow separation, weight, fabrication cost, failure mode analysis, failure rate potential and nozzle performance. As a result of these analyses, the U-tube concept was selected as the design for the divergent section. The U-tube concept is the preferred design since it has a higher margin of safety when considering the transient and steady-state loads, has a higher reliability because of fewer failure mechanisms, and has fewer potential coolant leak paths. (auth)

31979 (TID/SNA-381) FINAL REPORT OF SHIELD SYSTEM TRADE STUDY. Volume I. Book 3. S054-CP090290-F1, S054-023. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 268p. Dep. NTIS $16.50.

A shielding study of the NERVA engine is described. Topics covered include analytic methods, analyses of payload shielding, radiation analyses of alternative propellant tank shapes, problems associated with unmanned missions, and reliability. (JWR)

31980 (TID/SNA-382) PRELIMINARY EVALUATION OF A PROPOSED SCHEME FOR HYDROGEN RECOVERY FROM THE NERVA TURBOPUMP ASSEMBLY DEVELOPMENT PROGRAM, s004-ELH01-FACP121. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 38p. Dep. NTIS $4.75.

An evaluation of a proposed scheme for recovering a portion of the hydrogen expended during the NERVA Turbopump Development Program is presented. Essentially, this scheme utilizes a large area recuperator followed by a heater in the flow stream between the pump and turbine. The recuperator permits using most of the heat contained in the turbine discharge fluid to heat the pump discharge fluid (it has to be heated some way anyhow). At the same time, enough heat is removed from the turbine discharge gas to permit a fraction of it to be recovered as a liquid. There are two smaller heat exchangers in the process to improve the efficiency an additional 20%. The overall recovery factor for this system is 65%. (auth)

31981 (TID/SNA-393) MULTIPURPOSE PLANETARY PROBE MISSION. Vehicle Performance Analyses for E/J/S/U/N and E/J/S/P Tours for 1977 and 1979 Launch Opportunities.

Hatcher, G. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 321p. Dep. NTIS $19.25.

31982 (TID/SNA-397) THRUST VECTOR CONTROL GROUND TEST LIMITS TRADE STUDY, S054-CP090290-F1, S054-1018. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 129p. Dep. NTIS $9.50.

The results of a study for verification of NERVA engine gimbaling requirements during ground firing are presented. (JWR)

31983 (TID/SNA-408) PROPOSED STUDY OF THE INFLUENCE OF FISSION PRODUCTS ON THE OPERATION AND DESIGN OF NUCLEAR ROCKETS. (Aerojet-General Corp., Azusa, Calif. (USA)). Apr 1963. 12p. Dep. NTIS $4.00.

Fission products are a major concern in the selection of the design and operation of nuclear rockets. They play a primary role in determining a wide variety of reactor characteristics including excess reactivity requirements, temperature coefficient of reactivity, post-shutdown power generation and radiation effects. A review is presented showing the ways in which fission products affect the reactor characteristics and thereby influence the design and operating procedures of nuclear rockets. A program to study the role of fission products in nuclear rockets is recommended. (auth)

31984 (TID/SNA-414) QUALITY ASSURANCE INFORMAL PROGRESS LETTER 50A FOR THIRD QUARTER, CY 1969 COVERING APRIL, MAY, AND JUNE 1969. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jul 1969. 30p. Dep. NTIS $4.50.

Major problem areas requiring solution involved inadequate source inspection of bearings (reinspection and some reworking was required) and a failure mode analysis of the NERVA Altitude Simulation System. Other efforts involved review of design drawings, turbopump testing, turbopump bearing failure (corrected by design change), pressure transducer problems, actuator quality control, development of bearing inspection methods, etc. (LTN)

31985 (TID/SNA-415) 75K NERVA INTERNAL LOADS REPORT, S039-CP090194-F1. Rosser, R. C. Jr. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1969. 67p. Dep. NTIS $6.50.

The loading conditions, and therefore the analyses results, are dependent on: (1) the design of the various components, (2) the basic engine configuration, and (3) the eventual use of the particular item (i.e., ground test, flight, etc.). A change in any of these constraints will require that the loads analyses be revised. It is required that the handling and assembly loads be less than the primary design loads. Manufacturing procedures and handling equipment designs are analyzed to insure that this requirement is satisfied. It is required that the transportation loads also be less than the primary design loads. Proposed shipping containers and transportation methods and routes are analyzed. Launch loads include loads from the time of ignition of the launch vehicle on the launching pad to the time that the NERVA engine start up is initiated. These loads are presently based on the use of a S-IC First Stage, a S-II Second Stage, a modular nuclear third stage (SN), and a payload. Space operation (self-induced) loads result from turbopump operation, fluid flow, TVCS operation, actuator-valve operations, and nuclear thrust. Several configurations, including both manned and unmanned missions, are analyzed. There are two basic ground test configurations (with possible minor component variations) to analyze. One configuration is the basic engine which will be tested in a nozzle down attitude in ETS-1. The other configuration is reactor testing to be conducted in Test Cell C with the nozzle and reactor assembly inverted. Flight safety analyses include the additional loads imposed by flight safety considerations. Development and proof loads result from development and proof testing which may be more severe or different than the actual limit loads. They may include pressure vessel proof tests, nozzle chemical firings, etc. (auth)

31986 (TID/SNA-417) NERVA FUNCTIONAL FLOW DIAGRAMS, S052-SS090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1969. 77p. Dep. NTIS $7.00.

Diagrams present planned space operations for a mission from fabrication to ultimate disposal. (LTN)

31987 (TID/SNA-423) OPERATING LIMITS, NRX-A2 REACTOR. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Jun 1964. 28p. Dep. NTIS $4.50.

The constraints within which NRX-A2 reactor operations will be accomplished are defined. These limits include both Management Controls and Operational Controls. (auth)

31988 (TID/SNA-429) REON HOT GAS THERMOMETRY. Gilles, W. P.; McGrath, T. F.; Hoff, R. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 23p. Dep. NTIS $4.25.

Development of a sheathed W–Re thermocouple for use in measurement of hydrogen propellant temperature in NERVA rocket nozzle is reported. Information is included on coaxial designs, sheathed two-wire designs, thermocouple calibration, and thermocouple error. (JRD)

31989 (TID/SNA-438) NERVA RADIATION EFFECTS SUMMARY REPORT, S110-SR01-W181. Carlson, E.; French, W. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 178p. Dep. NTIS $12.00.

The results of radiation effects tests for the NERVA program from 1962 through June, 1968, are summarized. Also included is information obtained in the course of testing the NRX reactors. The early tests involved screening and development, while the latter tests were related more to reliability. The radiation effects data are summarized in tabular form, with references to the original reports, by instrument (device, manufacturer, model) or material (alloy, form), exposure temperature (sometimes anneal and test temperatures), neutron fluence and gamma dose, mode of failure and success ratio or (for materials) ultimate and yield strengths and elongation, reactor, test No., etc. Radiation effects on some bearing cage materials are reported. (LTN)

31990 (TID/SNA-452) PRELIMINARY NRDS TEST CELL "A" NERVA TURBOPUMP 65mm BEARING TESTING FACILITY REQUIREMENTS. Supplement. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. Contract SNP-1. 26p. Dep. NTIS $4.50.

Test Cell "A" facility and special test equipment requirements are presented for the evaluation testing of LH_2 cooled 65mm rolling element bearings for the NERVA engine TPA. (See also TID/SNA-455, 846). (DLC)

31991 (TID/SNA-455) NRDS TEST CELL "A" NERVA TURBOPUMP 65mm BEARING TESTING FACILITY REQUIREMENTS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1971. Contract SNP-1. 26p. Dep. NTIS $4.50.

Test Cell "A" facility and special test equipment requirements are presented for the "Evaluation Testing of LH_2 Cooled 65mm Rolling Element Bearings for the NERVA Engine TPA." (See also TID/SNA-452, 846). (DLC)

31992 (TID/SNA-458) SUPPLEMENTAL DESIGN CRITERIA NRDS TEST CELL "A" NERVA TURBOPUMP 65mm BEARING TEST FACILITY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1971. 46p. Dep. NTIS $5.50.

Test facilities and special test equipment for use in testing liquid hydrogen-cooled NERVA reactor turbopump bearings are described. Bearing development schedules including design, fabrication, and modification are summarized. (JRD)

31993 (TID/SNA-476) QUARTERLY PROGRESS REPORT FOR FIRST QUARTER CY 1971 COVERING THE PERIOD OF OCTOBER, NOVEMBER, AND DECEMBER 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. 374p. Dep. NTIS $21.75.

Research progress in the NERVA program is highlighted. (JWR)

31994 (TID/SNA-490) NERVA THRUST STRUCTURES. Component Design Report (Interim). Bonner, H. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 55p. Dep. NTIS $5.75.

The design of the thrust train for the NERVA Engine is governed by structural and functional requirements as well as physical interactions from neighboring components. The thrust train must transmit force due to engine thrust to the flight vehicle, provide a means for command adjustment of thrust vector (that is, contain a hinge joint), provide a single plane interface with the flight vehicle for mechanical, fluid, and electrical connections, and fit the prescribed dimensional envelope dictated by specific design features of the engine. The thrust structure design to meet the requirements imposed upon the thrust train contains two elements; an upper thrust structure, and a lower thrust structure. The upper thrust structure is a device which interfaces with the vehicle thrust frame on its upper face and with the engine gimbal pivot on its aft face. At the vehicle interface are assorted electrical and fluid remote couplings as well as remote mechanical connections for in-flight replacement of the engine assembly. Fundamentally, the upper thrust structure is an arrangement of girders within a circular box beam constructed entirely of aluminum sheet, extrusions, and forgings. The lower thrust structure interfaces functionally with the upper thrust structure thru the gimbal pivot to form the thrust train from the thrust chamber (pressure vessel and nozzle containing the nuclear reactor) to the flight vehicle. The lower thrust structure serves as a mount for the bulk of propellant feed system components, as well as a mount for a nuclear radiation shield for manned flight applications. The fundamentals of the design of the lower thrust structure are a

cylindrical thin-walled column which transmits engine thrust to the gimbal pivot through a conical transition section with a crossed truss interface with the gimbal pivot. Attached to the surface of the structure are assorted mounting pads and framework for the propellant feed system components and radiation shield. Design studies of the thrust structure for the NERVA engine have produced upper thrust structure and lower thrust structure concept designs which represent logical, but not completely optimized, approaches to fulfillment of the design objectives. (auth)

31995 (TID/SNA-525) NERVA TURBOPUMP DESIGN REPORT. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 257p. Dep. NTIS $16.00.

The NERVA Turbopump (TPA) configuration, a two stage centrifugal pump driven by a two stage axial turbine, is the culmination of several studies which balanced performance against weight, size, and reliability. TPA performance requirements, as specified in EC-90149, included steady state operation at two points, 45 lb/sec flow rate at a shaft speed of 24,600 rpm, with 1400 psi pump discharge pressure, and 73 lb/sec flow rate at a shaft speed of 27,000 rpm and 1300 psi pump discharge pressure. The above-mentioned steady state points were to be achieved for a maximum of 60 engine starts with a total duration of 10 hours operation. Consideration of a limited (10% shaft speed) overspeed condition led to a maximum TPA operating condition of 43 lb/sec flow rate at 30,000 rpm shaft speed, with 1800 psi pump discharge pressure. The reliability of the TPA, in the above steady state operating conditions was to be commensurate with the 0.995/90 engine reliability. This led to a high margin of safety requirement on a component basis. Consideration of rotor dynamics, strength to weight ratio, and bearing life requirements led to the selection of titanium (5 Al–2.5 Sn ELI) as the prime rotor material candidate, with A286 as the backup rotor material. Environmental and fabrication considerations led to the selection of 310 SS as the prime TPA housing material candidate. The total (rotor and housing) pump and turbine housing performance was verified by air test, and the inducer and turbine blading natural frequencies were verified by holographic techniques. The fluid and hydrodynamics predictions of TPA performance, as well as the thermal analysis of the TPA, were then used as input for the structural analysis of the TPA. The major considerations in the mechanical design were the bearing life, component distortion, i.e., rubbing, and component stress level, as affected by the pressure and thermal distributions. (auth)

31996 (TID/SNA-534) REPLACEABLE SHIELD DESIGN STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 48p. Dep. NTIS $5.50.

An addition to the NERVA Engine design requirements was imposed by Change Order 70-8; requiring the external shield to be remotely replaceable. This design study was conducted at the engine level to determine the most satisfactory general design approach for satisfying this requirement. The reference shield configuration, using lead for gamma shielding and mechanical means for remote replacement, was investigated and two shield/thrust structure concepts were developed. Alternate gamma shielding materials were also investigated with such material forms as powder, shot and liquid metal considered, and design concepts were developed for shield configurations with these alternates. The alternate materials offered the smallest penetration in the thrust structure for extraction of the central portion of the external shield. Comparisons of the various concepts were made with attention directed to weight, minimizing engine and AGE design complexity, relative simplification of remote space operations and maintaining the shield attenuation capability. The study concludes that the most satisfactory design approach is that afforded by the reference shield configuration using lead for gamma chielding and mechanical means for remote replacement. (auth)

31997 (TID/SNA-535) E-1 COMMON ANALOG MODEL, REVISION 6.1 (RN-S-0469). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 29 Dec 1970. 15p. Dep. NTIS $4.00.

31998 (TID/SNA-536) ENGINEERING OPERATIONS REPORT: LH_2 PUMP COMPONENT DEVELOPMENT TESTING IN THE ELECTRIC PUMP ROOM AT TEST CELL "C" INDUCER NO. 1. Final Report. Andrews, F. X.; Brunner, J. J.; Kirk, K. G.; Mathews, J. P.; Nishioka, T. 'Aerojet-General Corp., Sacramento, Calif. (USA)). May 1972. 405p. Dep. NTIS $23.25.

The NERVA Engine requirements determine that the turbopumps shall have certain performance characteristics. To ascertain the conformance of the pump characteristics to the requirements and to identify any problems associated with its performance, early component testing of various pump configurations was desirable and was accomplished to support the final design selection. The NERVA Pump will be a two stage centrifugal pump with both stages having backswept impellers and an inducer upstream of the first stage impeller. The component tests were conducted with liquid hydrogen at Test Cell "C" and investigated the performance of the first stage components. The first stage configuration tested consisted of an inducer, impeller and a vaned diffuser followed by a pump volute. All objectives were successfully accomplished including: Provision of performance data of various pump components under consideration; provision of cavitating performance data of the initial configuration inducer; determination of the test rig shaft critical speed of 29,250 rpm (this agreed with the pretest predicted critical speed of 30,000 rpm); measurement of the radial thrust; and verification that the axial thrust was within the capabilities of the bearings. In most cases the normal performance of the overall test article and individual components agreed with the pretest prediction and met or exceeded the design requirements. (auth)

31999 (TID/SNA-553) NERVA MANAGEMENT PLAN. Volume II. Logic Diagrams. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 251p. Dep. NTIS $15.75.

32000 (TID/SNA-556) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PROPELLANT INLET LINE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 13p. Dep. NTIS $4.00.

This specification establishes the requirements for performance, design, test, and qualification requirements for NERVA equipment identified as propellant inlet lines (PIL). The PIL transports propellant from the propellant shutoff valve (PSOV) to the turbopump inlet. (auth)

32001 (TID/SNA-557) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR GIMBAL ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 9p. Dep. NTIS $4.00.

Part I of two parts.

A specification is presented which establishes the performance, design, test, and qualification requirements for the Nerva engine gimbal actuator. The gimbal actuator forms a part of the gimbal assembly subsystem and is listed as a design critical component in detail specification EC-90244. The gimbal actuator consists of an electrical amplifier, an actuator motor, a linear drive mechanism, and a feedback network. (auth)

32002 (TID/SNA-558) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PROPELLANT SHUTOFF VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 13p. Dep. NTIS $4.00.

Performance, design, test, and qualification requirements for the propellant shutoff valve assembly for the NERVA full-flow engine are presented. (JWR)

32003 (TID/SNA-559) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR NOZZLE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 12p. Dep. NTIS $4.00.

32004 (TID/SNA-563) NERVA TURBOPUMP ASSEMBLY. Volume II. Mechanical Design, Instrumentation, and Nuclear Radiation Analysis. (Aerojet-General Corp., Sacramento, Calif. (USA)). 24 Sep 1971. 267p. Dep. NTIS $16.50.

The NERVA Turbopump (TPA) configuration, a two stage centrifugal pump driven by a two stage axial turbine, is the culmination of several studies which balanced performance against weight, size, and reliability. The reliability of the TPA was to be commensurate with the .995/90 engine reliability which lead to a high margin of safety requirement on a component basis. Consideration of rotor dynamics, strength to weight ratio, and bearing life requirements lead to the selection of titanium (5 Al-2.5 Sn ELI) as the prime rotor material candidate. The major considerations in the mechanical design were the bearing life, component distortion, i.e., rubbing, and component stress level, as affected by the pressure and thermal distributions. Critical radial clearances between the turbopump rotor and housing are established through the use of close running labyrinths, with exception of the inducer tip to housing relationship. These clearances are described relative to their dimension, running clearance, environment, material and function. The eccentricities of all housing clearance diameters will be held to .0005 by line grinding at assembly. In a similar manner the rotor diameters will also be held to .0005 eccentricity. Turbopump instrumentation provides for pressure and temperature measurements at the pump discharge and turbine inlet and discharge. Bearing and thrust balancer flowrates and bearing coolant fluid temperature rise are provided. Turbine flowrate, pump flowrate, pump inlet pressure and temperature, and pump inlet fluid vapor fraction will have to be provided by instrumenta-

tion external to the turbopump. The radiation heating of the pump, and particularly the bearings, was calculated by the Monte Carlo method. (auth)

32005 (TID/SNA-565) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR MIDDLE THRUST STRUCTURE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 8p. Dep. NTIS $4.00.

Part I of two parts.

A specification is presented which establishes the performance, design, test, and design verification requirements for equipment identified as the Nerva engine middle thrust structure. It is a part of the subsystem described as the thrust structural subsystem and is listed as a design critical component in detail specification EC-90152. (auth)

32006 (TID/SNA-570) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR COOLDOWN LINES. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 14p. Dep. NTIS $4.00.

Part I of two parts.

A specification is presented which establishes the performance, design, test, and qualification requirements for the cooldown supply lines (CSL). The CSL transports propellant from the main propellant tank to the structural support coolant line inlet flange in the Nerva engine. (auth)

32007 (TID/SNA-590) NERVA ENGINE PURGE UNIT REQUIREMENTS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 40p. Dep. NTIS $5.00.

The propellant feed system specification requires a provision for purging with inert gas during all ground, launch and boost operations. This purge is necessary to achieve the inertness required to protect the engine system from chemical attack causing material degradation, hydrogen-oxygen explosions, or icing-caused bearing freeze-up or dynamic seal stickage, etc. The technical requirements for attaining sufficient purge of the NERVA engine were formulated. It was determined that system inertness level requirements are as follows: maintain a moisture level of 15 ppM (by volume) or less, a total condensible gas level of 1 percent (by volume) and limit chlorine, fluorine, and acetic acid to 2 micrograms per gram each or less. A study of several purge systems and methods was made. The candidate systems were analyzed quantitatively for purge time, amount of purge gases consumed and best combination of purge gas to achieve minimum required system cleanliness level. (auth)

32008 (TID/SNA-596) NERVA INCENTIVE FEE APPROACH. (Aerojet-General Corp., Sacramento, Calif. (USA)). 14 Apr 1967. 34p. Dep. NTIS $4.75.

Well structured incentive fee arrangements in contracts are desirable and encouraged by Aerojet, since such incentives are normally designed to reward the contractor in calculable monetary terms for providing improved product performance, improved schedule compliance and lesser cost. Incentivized contracts provide many advantages to the government. In addition to possibly providing a better product in less time at a lower cost, incentivized contracts normally require less attention and management by the government. The structuring of multiple incentive features in a contract requires the existence in the contract of certain prerequisites. Most importantly, the contract must require achievable goals unencumbered by major technical advancement requirements or constraints such as funding availability. Notwithstanding our desire to perform the contract under incentivized fee arrangements, we sincerely believe that a multiple incentive approach at this time is premature. The complexities in the factors examined, although not precluding an incentive approach, make it extremely difficult to apply multiple incentives to program modules with any assurance that results would be consistent with objectives. Based on the above, Aerojet recommends the contract provide an incentive of the award type based on a combination of objective and subjective (coordinated) evaluations, plus a plan to convert portions of the contract to multiple incentive arrangements at the earliest appropriate time. (auth)

32009 (TID/SNA-598) NUCLEAR ROCKET UNCOOLED NOZZLE STUDY PROGRAM. Final Report. Schindler, R. C.; Dickson, J. C. (Aerojet Liquid Rocket Co., Sacramento, Calif. (USA)). 30 Apr 1970. 92p. Dep. NTIS $7.75.

The objective was to study the feasibility and effects of substituting an "uncooled" nozzle (radiation-cooled) for the current 75K NERVA regeneratively-cooled nozzle for improved performance and reliability. Design concepts were screened with regard to materials, fabrication approaches, coatings, and structural and thermal considerations, including heating due to attenuation of nuclear radiation. Then a comparative analysis was made of the most promising design candidates. Finally a further evaluation was performed on the most promising nozzle and attachment concept. The selected nozzle concepts were nonmetallic designs made of fibrous graphite material (AGCarb-101) infiltrated with a metallic carbide on the heated surface. Metals were found to be unfeasible for this application due to the high operating temperatures and secondary radiation effects. Nonmetallic fibrous graphite has the highest strength-to-weight ratio at the operating temperature of any material considered, and computer calculations show that the material has acceptable nuclear heating rates. It can be fabricated with state-of-the-art technology, although it must be protected from corrosion by an infiltrant or barrier. The chemical barriers have been demonstrated to be entirely adequate at low pressures, but further investigations are necessary to determine the effect of higher pressures. Attachment of the uncooled nozzle to a rigid pressure vessel was a problem area requiring major design attention. The principal attachment methods that were considered included (1) regeneratively-cooled transition sections, (2) film-cooled interface regions, and (3) recessed designs in which the nozzle is clamped rather than bolted in place, and there is freedom to grow radially. The recessed designs were favored from thermal and structural standpoints. The uncooled nozzle shows a potential performance advantage of approximately 5 sec of specific impulse over the current regeneratively-cooled nozzle concept. Additional system performance gains may be possible from the reduced nozzle weight (500 lb) and lower pump discharge pressure requirements. (auth)

32010 (TID/SNA-603) FLUIDIC CONTROLS FOR THE NERVA ENGINE. Fourth Semiannual Progress Report Covering November 1969–April 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 217p. Dep. NTIS $14.00.

Several new fluidic control concepts were explored either experimentally or analytically. Basic component and subsystem design data at simulated engine state-point conditions were secured. Component design effort during the next six months will include fabrication and simulated tests of selected "breadboard" configurations. (auth)

32011 (TID/SNA-604) QUARTERLY PROGRESS REPORT FOR SECOND QUARTER CY 1970 COVERING THE PERIOD OF JANUARY, FEBRUARY, AND MARCH 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 410p. Dep. NTIS $23.50.

The NERVA engine concept selection was made on the basis of the results of recent trade studies and other analyses. Most ANSC recommendations were accepted by SNPO-C and redirection authority was received. Program logic is being evaluated in an attempt to schedule PDR at the earliest time possible, consistent with other goals such as specification maturity. Component design and specification preparation is continuing, based on the latest layout drawing, No. 1137400A. Technology test data received continued analysis. Computer codes and analytical models were updated and rechecked. The NRX and XE-Prime test series were analyzed and all data can be successfully predicted which allows a high degree of confidence in the computer models. Some of the significant conclusions resulting from the continued study of XE-Prime data include increased confidence in radiation analysis and predictions, and increased confidence in the nozzle-chamber specific impulse prediction. Maintainability studies showed that, on the basis of cost, the engine should be replaceable on the vehicle. On the launch pad it would be more effective to replace critical components for maintainability. All valves, actuators, and turbomachinery should be replaceable, packaged into modules for modular replacement. A draft of "Maintenance Support Concept and Maintainability Guidelines" was completed for review. Calculation of the radiation environment is more complex for ground testing within the engine test compartment where facility contributions must be included, than for the flight environment where only engine sources would be present. For this reason, a high level of confidence can be established to predict the less-complex flight environment. Increased effort was applied toward establishing and reducing engine weight. Weight-control procedures were developed and studies initiated to establish maximum allowable weights for specific missions. The internal review draft of the Mass Properties Report was prepared. Specifications for various reactor components were updated. (auth)

32012 (TID/SNA-605(Pt.1)) ENGINE/COMPONENT DESIGN STATUS REVIEW. Phase II. Book I. Engine, Methods, and Ongoing Components. Presentations to SNSO, Sacramento, May 1971. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 320p. Dep. NTIS $19.00.

Material presented at a design status review meeting on the NERVA engine, methods and ongoing components has been documented. Items covered relate to operations, performance, reliability, safety, shielding and control systems. Also the results of thermal and structural analyses are included. (LTN)

32013 (TID/SNA-605(Pt.2)) ENGINE/COMPONENT DESIGN STATUS REVIEW. Phase II. Book 2. Engine, Methods, and Ongoing Components. Presentations to SNSO, Sacramento. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 293p. Dep. NTIS $17.75.

Slides presented at a design status review meeting have been documented. The presentation was quite detailed and includes many drawings, test results, material properties, and the status of the various components (pressure vessel, nozzle assembly, thrust structures, shielding, some valves and actuators, and reactor instrumentation) as of this date. (LTN)

32014 (TID/SNA-605(Pt. 3)) ENGINE/COMPONENT DESIGN STATUS REVIEW. Phase I. Four Ongoing Components Presentations to SNSO, Sacramento. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 6 Apr 1971. 415p. Dep. NTIS $23.75.

The development status of the nozzle and nozzle extension, turbopump, valves, actuators, etc. for the 75K, Full Flow NERVA engine was reviewed. (LTN)

32015 (TID/SNA-610) NERVA CONTAMINATION AND CORROSION CONTROL PLAN. Lamvermeyer, D. J.; Murchison, M. L. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 87p. Dep. NTIS $7.50.

The purpose of the Contamination and Corrosion Control Plan is to provide information and guidance that will help design engineers, quality-assurance engineers, fabrication engineers, materials and processes engineers, test engineers, and maintenance personnel to define criteria and areas of concern to prevent, control, identify, and treat various forms of contamination and corrosion in the NERVA engine system and associated ground-support equipment. The designer is given specific methods of controlling contamination in product design and a detailed listing of the factors affecting contamination in hardware. Comparisons of methods of cleaning and drying are presented. A listing of applicable cleaning specifications and standards is given. Methods of packaging and storage for maintenance of product cleanliness level are discussed. Corrosion control is presented from the view that control is best implemented through a thorough understanding of probable corrosion mechanisms and selection of materials, coatings, processes, and configuration control to mitigate probable corrosion mechanisms. Means of lessening these mechanisms are discussed as are test requirements for materials and processes. Quality-control requirements, corrective action, and corrosion-control preventive maintenance are outlined. (auth)

32016 (TID/SNA-625) MULTIPLEXER LOCATION STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 86p. Dep. NTIS $7.25.

The advantages and disadvantages of four data acquisition system concepts for the NERVA engine are compared with regard to weight, reliability, interface complexity (engine-to-stage), system complexity, maintainability, and development costs and times. The dominant considerations are state-of-the-art (April 1970) radiation tolerances of building-block devices and circuits, the engine nuclear radiation environment, radiation shielding required to obtain high-reliability (aerospace, man-rated) performance, and potential cable weight savings. Conclusions are that the data acquisition electronics should not be located in the engine environment (below the propellant tank); however, the changing state-of-the-art in radiation hardened electronics could produce devices which would alter the study results. (auth)

32017 (TID/SNA-644) ETS-1 OPERATIONS SUMMARY REPORT FOR PERIOD 1963-1969. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 233p. Dep. NTIS $14.75.

Summaries are presented on rocket test facility component performance checking. Results of operational tests are given on valves, gas systems, test stand thrust rings, water systems, cryotraps, railway systems, pressurizers, He purge systems, hydraulic systems, acoustic systems, electrical systems, nuclear exhaust systems, steam generators, and engine test compartments. (JRD)

32018 (TID/SNA-651) MULTIPURPOSE PLANETARY PROBE MISSION. Vehicle Performance Analyses for E/J/S/U/N and E/J/S/P Tours for 1977 and 1979 Launch Opportunities. Hatcher, G. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 322p. Dep. NTIS $19.25.

32019 (TID/SNA-654) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PUMP DISCHARGE CHECK VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

Part I of two parts.

This specification establishes the performance, design, test and qualification requirements for NERVA equipment identified as Pump Discharge Check Valve and Actuator, hereinafter referred to as PDKV Assembly. The PDKV Assembly shall be capable of preventing backflow to the pump during engine malfunction operating mode. (auth)

32020 (TID/SNA-655) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR BY-PASS BLOCK VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

Part I of two parts.

This specification establishes the performance, design, test and qualification requirements for NERVA equipment identified as Bypass Block Valve and Actuator, hereinafter referred to as BBV Assembly, consisting of a valve and an electro-mechanical actuator system. The BBV assembly is to permit flow to by-pass the turbine during engine operation and to terminate flow through the turbine by-pass flow path. (auth)

32021 (TID/SNA-657) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR COOLANT SUPPLY CHECK VALUE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

Part I of two parts.

A specification is presented which establishes the performance, design, test, and qualification requirements for equipment identified as cooldown supply check valve and actuator, hereinafter referred to as CSKV Assembly. The CSKV Assembly is to prevent backflow to the cooldown system control valve (CSCV) during engine operation. (auth)

32022 (TID/SNA-660) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR GIMBAL ASSEMBLY SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 21p. Dep. NTIS $4.25.

Part I of two parts.

32023 (TID/SNA-674) TCR 9660-002: NERVA INJECTOR DEVELOPMENT FOR CY 63. Heinicke, D. R. (Aerojet General Corp., Sacramento, Calif. (USA)). 17 Jan 1964. 28p. Dep. NTIS $4.50.

Since there are no nuclear reactor facilities available at AGC-Sacramento, alternative methods had to be devised to expand the propulsive gases for testing the NERVA nozzle. The method selected was to mix liquid oxygen with the liquid hydrogen and combust the mixture. This required the development of injectors to provide a mixture that would combust and duplicate, as nearly as possible, the conditions that would be experienced by the NERVA nozzle during an actual firing. From the results of experiments performed: It is concluded that (1) the data available is insufficient to adequately determine the feasibility of stainless steel face plate injectors for NERVA simulation testing. (2) The orifice pattern design tested is unsatisfactory from the standpoint of face plate erosion with the oxidizer flow rates used. However, this design may be satisfactory when operating in the region of 140 lb/sec, the oxidizer flow for which the pattern was designed. Further testing is necessary to evaluate stainless steel face plate injectors for NERVA simulation. (auth)

32024 (TID/SNA-675) TCR 9660-004: HOT BLEED DEVELOPMENT TEST PLAN. Heinicke, D. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Apr 1964. 30p. Dep. NTIS $4.50.

The objective of this planned test program is to demonstrate by testing the capability of the hot-gas port and turbine inlet line to perform satisfactorily under nuclear conditions, except for nuclear radiation effects. The hot-gas port and line will be evaluated for structural integrity, mixing efficiency of the diluent with the hot gas from the chamber plenum, resistance to erosion, reliability, ability to withstand nuclear heat flux and wall temperatures, and overall system compatibility. (auth)

32025 (TID/SNA-678) MARS INTEGRATED EXPLORER MISSION VEHICLE PERFORMANCE ANALYSES FOR A 1981 MISSION TO MARS. Appendix D. Hatcher, G.; Levite, R. H. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 32p. Dep. NTIS $4.75.

Various alternative designs, vehicle characteristics, payloads, propellant loads, etc. are considered in evaluating a proposed mission to Mars. (LTN)

32026 (TID/SNA-681) PROPELLANT FEED SYSTEM TRADE STUDY 101 AND TURBOPUMP ASSEMBLY TRADE STUDY 102. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 504p. Dep. NTIS $28.25.

The objectives of the propellant feed system (PFS) trade study were to select the optimum feed system which would meet the performance, reliability, and safety requirements set forth for the

NERVA engine. Since the PFS comprises a major segment of the entire engine system its importance is of significant magnitude. The conclusions reached directly affect engine complexity, component performance requirements, central and stability implications and ultimately achievable payload. The study considers PFS configurations using single or multiple TPAs in alternate flow schemes and with appropriate valving and control concepts on the basis of their ability to meet the performance and safety requirements stated in the NPRD and the potential of meeting reliability requirements. Conclusions and recommendations based on qualitative and semi-quantitative system analyses are provided. (auth)

32027 (TID/SNA-686) SYSTEM COST-EFFECTIVENESS MODEL REPORT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. 226p. Dep. NTIS $14.50.

The objective of this study was to develop the appropriate mathematical routines and construct a system cost-effectiveness computerized model. The model provides the capability of establishing the cost effectiveness of tradeoffs resulting from changes in engine configuration, design variables, or operational procedures. The system cost-effectiveness mathematical model has the capabilities for providing information for evaluating the cost effectiveness of alternate engine configurations, maintenance concepts, and such engine or component design parameters as specific impulse, thrust, weight, reliability, and life. To evaluate engine design conditions and space traffic patterns on a common basis, cost, in terms of dollars per pound of payload delivered to destination orbit, was selected as the figure of merit to measure system effectiveness. The total cost per pound of payload includes engine development costs, engine and stage production costs, launch and launch support costs, orbital support costs (e.g., maintenance, storage, and assembly), and disposal costs. A program option allows engine and stage production costs (identified as item costs in the program) to be either input on a per unit basis or computed dependent upon the traffic pattern, which is determined by the total annual payload and the life of the engine, stage and launch vehicle. (auth)

32028 (TID/SNA-688) OVAL VERSUS U-TUBE NERVA NOZZLE DIVERGENT SECTION DESIGN STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 97p. Dep. NTIS.

In Trade Study 301, the U-tube concept was selected on the basis of higher reliability over the oval-tube concept mainly because the U-tube jacket provides a positive pressure containment with no external leakage problem. Therefore, the oval-vs-U-tube NERVA nozzle divergent-section design study was conducted to verify the higher reliability of the U-tube concept by constructing an extensive chart depicting failure-mode analyses and respective mechanisms and failure-rate-potentials. In support of final concept selection, comparative analysis was also conducted for the following items: Dynamic loads imposed upon the 29 : 1 nozzle assembly as a result of flow separation; weight; fabrication cost; and payload equivalency. The U-tube concept is still the preferred design since it has a higher margin of safety when considering transient and steady-state loads, has a higher reliability because of fewer failure mechanisms, and has fewer potential coolant leak paths. The fabrication cost is approximately the same for both. The oval-tube concept does have a slight weight advantage; however, this could be negated if the oval-tube bundle is further reinforced to have a margin-of-safety comparable with that of the U-tube concept. (auth)

32029 (TID/SNA-690) NERVA VALVE/ACTUATOR CONCEPT SELECTION. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 453p. Dep. NTIS $25.75.

The valve and actuator requirements in the NERVA engine are discussed. The concepts considered and the selections made are described. (JWR)

32030 (TID/SNA-711) NERVA NOZZLE BOLT COOLANT SYSTEM DESIGN STUDY REPORT, s054-DS301-W141-24. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 58p. Dep. NTIS $6.00.

In this design study, two methods of providing coolant to the nozzle/pressure-vessel flange and bolts were evaluated, and the optimum number of nozzle/pressure-vessel attaching bolts was selected. The methods were limited to external and internal feed concepts. The internal feed design is the desired concept on the basis of a preliminary evaluation of advantages and disadvantages. To select a design, the required number of bolts was determined; and the two concepts were compared on the basis of failure mode analysis and failure rate potential. After selection of the internal cooling concept, further study was conducted to evaluate the design on the basis of: Stress analysis of flange area; and fluid analysis at nominal, malfunction, transient, and feed hole tolerance conditions. (auth)

32031 (TID/SNA-721) PRELIMINARY ANALYSIS OF ETC/NASS DYNAMIC REPRESSURIZATION AND AIR INTRUSION CHARACTERISTICS. Bailey, W. G.; Thompson, W. R.; Mockenhaupt, J. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1971. 84p. Dep. NTIS $7.25.

The dynamic response characteristics of the Engine Test Compartment and the Exhaust Duct were evaluated in terms of system repressurization and air intrusion. This preliminary analysis considered system dynamics as resulting both from normal engine operation and from malfunctions of the engine and Secondary Ejector flow supplies. Analytical techniques were limited to a modified version of those employed to solve a similar problem during XE testing. For normal operation of the engine and associated test facilities, no structure-damaging overpressures or air intrusion problem are predicted. An engine flow malfunction at full power (no steam) with instantaneous loss of flow results in an ETC pressure of 16.7 psia; no overpressure is predicted for an engine depressurization rate of −60 psi/sec. An instantaneous loss of secondary flow results in an ETC pressure of about 19 psia, far above the design limit of 14.8 psia. For the case of secondary loss during pulse cooldown (initial steam nozzle chamber pressure of about 200 psia), the maximum permissible depressurization rate for secondary steam flow is of the same order. Appreciable quantities of air enter the system at high rates of steam depressurization. Attempts to supply an inert purge to eliminate air intrusion at the flow rates required in the time period of interest will require a very high response system which adds the purge gas directly into the plenum. A better approach may be to adopt a design which will insure that credible malfunction steam depressurization rates will have a maximum on the order of −50 psi/sec. It should be emphasized that these calculations are based on a highly simplified model of a very complex physical system so the conclusions can only be considered preliminary. Scale-model tests of flow dynamics with high-response instrumentation must be conducted to verify the model and to properly assess the system influence coefficients. (auth)

32032 (TID/SNA-726) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR NOZZLE ASSEMBLY SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 18p. Dep. NTIS $4.00.

Part I of two parts.

32033 (TID/SNA-727) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR THRUST STRUCTURE SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 14p. Dep. NTIS $4.00.

32034 (TID/SNA-729) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR BY-PASS CONTROL VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 19p. Dep. NTIS $4.00.

32035 (TID/SNA-730) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE BLOCK VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

32036 (TID/SNA-731) NERVA DETAILED SPECIFICATION. Part I. Performance/design and qualification requirements for turbopump assembly. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 76p. NTIS $7.00.

The TPA is an integral assembly consisting of a pump, turbine and associated instrumentation. The turbine drive fluid shall be the heated hydrogen of the engine. The TPA is a part of the TPA and valves module which consists of a TPA, a Turbine Block Valve (TBV), a Turbine Discharge Block Valve (TDBV), and a pump discharge check valve assembly consisting of a Pump Discharge Check Valve (PDKV) and an Actuated Pump Discharge Check Valve (PDKVA). Two TPA and valves modules are utilized in the NERVA engine and operate in parallel during normal mode operation. The TPA shall be capable of operating in a malfunction mode (single turbopump operation) when one TPA and valves module is inoperative. The TPA as installed in the TPA and valves module shall develop the performance as specified herein for all modes of engine operation as specified in CP-90290 within the limits and under the conditions specified herein. (auth)

32037 (TID/SNA-732) NERVA DETAILED SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Bypass Control Valve. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 71p. Dep. NTIS $6.75.

The BCV assembly consists of a valve, an electro-mechanical actuation mechanism, and an actuator driver; and is used in the turbine bypass module which consists of two parallel flow paths each containing a BCV assembly and a Bypass Block Valve (BBV) assembly. During engine operation the BCV as-

semblies are in parallel with the turbines and are used to control the flow of gaseous hydrogen around the turbines and as a cooldown path. Both BCV assemblies shall actively control hydrogen bypass flow during all engine operational modes specified in CP-90290. Each BCV assembly shall also be capable of individually providing the required flow control in the event of a malfunction in the other flow path. The performance of the BVC assembly as installed in the turbine bypass module shall be within the limits and under the conditions as specified herein. (auth)

32038 (TID/SNA-734) DETAIL SPECIFICATION: PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ENGINE, NERVA, 75K, FULL FLOW. Part I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 29 Jun 1970. 89p. Dep. NTIS $7.50.

Design requirements are presented for the 75K, Full Flow NERVA engine (CP-90290). (LTN)

32039 (TID/SNA-743) CONTRACT END ITEM REPORT: ENGINE INSTALLATION VEHICLE, PART No. 89-71-1000. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 276p. Dep. NTIS $17.00.

The Engine Installation Vehicle (EIV) is a special purpose railway flatcar equipped to install the NERVA engine in the Engine Test Stand, remove it and transport it to and from the Engine Maintenance and Disassembly Building (E-MAD). During hot engine handling operations the EIV is controlled from the MCC. During cold operations, a portable controller is available for optional use. A description is provided of the design and development changes, fabrication, factory testing, installation, checkout and final acceptance testing of the EIV. (auth)

32040 (TID/SNA-745) DESIGN AND DEVELOPMENT OF LH_2 COOLED ROLLING ELEMENT RADIAL BEARINGS FOR THE NERVA ENGINE TURBOPUMP. Phase I, January 1969–December 1971. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1969. 569p. Dep. NTIS $31.50.

The development and testing of LH_2 cooled rolling element radial bearings for the NERVA turbopump is described. The design is shown in pictures and the choice of materials is discussed. A major part of the work deals with the testing of these bearings and how the time and cost of testing was shortened by testing overloaded bearings and by using certain statistical methods which shortened the testing time. The effects of radiation on some cage materials is discussed, as is also the kind of wear and of failures encountered in test bearings. (LTN)

32041 (TID/SNA-746) NERVA TURBOPUMP DESIGN REPORT. Volume II. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 187p. Dep. NTIS $12.50.

32042 (TID/SNA-756) F004CP091295AG1 FACILITY REQUIREMENTS DOCUMENT: NRDS TEST CELL "A" NERVA TURBOPUMP 65MM BEARING TESTING FACILITY REQUIREMENTS. Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1971. 26p. Dep. NTIS $4.50.

Facility and equipment requirements for evaluation of liquid hydrogen cooled NERVA engine bearings are presented. A description of test bearings is included along with information on test operations, quality assurance, safety, test cell performance, and system readiness. (JRD)

32043 (TID/SNA-757) REQUIREMENT ALLOCATION SHEETS, S053-CP090205-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 417p. Dep. NTIS $24.00.

The results of a functional analysis performed on the NERVA (75K) Flight Engine and designated missions are presented in the form of Requirements Allocation Sheets (RAS's) as specified by AFSCM 375-5. Engine and mission baseline requirements are stated in SNPO Document No. SNPO-NPRD-1. The intent is to establish positive correlation between the Engine/Mission functional requirements, and Engine/Support Equipment design requirements. This correlation will serve as engineering reference points to provide for the progressive and evolutionary development of specifications and associated data. (auth)

32044 (TID/SNA-772) ENGINE SYSTEM EVALUATION OF STRUCTURAL SUPPORT COOLANT SYSTEM, S054-CP090290-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 76p. Dep. NTIS $7.00.

An engine system evaluation of the structural support coolant system (SSCS) is presented. The basic requirements of the SSCS are to provide sufficient coolant to prevent overheating of the stems (unfueled elements providing structural support for the core) and to provide controlled hydrogen flow for the reactivity control requirements of cold-to-hot criticality uncertainty, corrosion compensation, throttling, and reactor temperature control. An additional requirement of the SSCS is to provide bypass flow to cool the stem exit flow below the support plate temperature constraints. (auth)

32045 (TID/SNA-776) s110 RADIATION EFFECTS ANALYSIS REPORT-NOZZLE, s110-XAN08-W181f1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 23p. Dep. NTIS $4.25.

An analysis of the availability of data for the candidate nozzle materials with respect to the anticipated nuclear environment and the properties required for design has been completed. The information required to complete the acquisition of suitable data has been outlined on the appropriate Radiation Effects Information Request (REIR) forms. Previous reactor tests have supplied information on tensile properties within the general fluence/temperature range of the NERVA requirements for the nozzle candidate materials except for ARMCO 22-13-5. Each test was small in scope and served to provide answers for particular situations. None of the tests provides sufficient experience comparable to the properties and fluences dictated by the presently specified NERVA engine useful life which is 10 hours. Fatigue properties at elevated temperatures are required for nozzle tube sheet material. This property has not been evaluated for the irradiated materials. Non-irradiation fatigue tests in progress will determine whether a sufficient margin in fatigue strength exists to preclude testing irradiated tube materials. (auth)

32046 (TID/SNA-778) RADIATION EFFECTS ANALYSIS REPORT: PRESSURE VESSEL AND CLOSURE, s110-XAV12-W181f1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 21p. Dep. NTIS $4.25.

An analysis of the availability of data for the candidate pressure vessel and closure materials with respect to the anticipated nuclear environment and the properties required for design has been completed. The information required to complete the acquisition of suitable data has been outlined on the appropriate Radiation Effects Information Request (REIR) forms. Previous reactor tests have supplied information on tensile properties within the general fluence/temperature range of the NERVA requirements for materials in the pressure vessel and closure subsystem except for the MP35N Multiphase nickel–cobalt base alloy. Some of the expected radiation effects on aluminum alloys are inferred from experimental data for similar material conditions or from data related to forms other than forgings. The worst conditions, i.e., low temperature, high fluence, have not been covered in the experimental work. In addition, fracture toughness information is required, as well as tensile properties, due to the low ductility expected in most of the alloys at the extreme environmental conditions. (auth)

32047 (TID/SNA-780) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Pressure Vessel and Closure. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 71p. Dep. NTIS $6.76.

A specification is presented which establishes the performance, design, test, and qualification requirements for equipment identified as the pressure vessel and closure (PVC). It is a part of the contract end item described as Engine, NERVA, 75K, Full Flow and is listed as an engineering critical component in detail specification CP-90290. (auth)

32048 (TID/SNA-783) LH_2 PUMP COMPONENT DEVELOPMENT PRELIMINARY TEST PLAN. Andrews, F. X.; Nishioka, T. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 23 Jul 1970. 12p. Dep. NTIS $4.00.

The pump LH_2 component development program will be conducted to support the component design selection for the NERVA turbopump. The program will be divided into two phases. Phase I will investigate the performance and operating characteristics of the inducer, first stage impeller, and pump volute. Phase II will investigate the performance and operating characteristics of the second stage impeller with its integral thrust balancer and the pump volute. The LH_2 tests will be conducted in the electric motor drive facility located in Test Cell "C" at NRDS which is capable of delivering 6000 horsepower at 34,645 rpm. The test article will be designed to accommodate both Phase I and II with a minimum of hardware modifications. (auth)

32049 (TID/SNA-821) SUMMARY REPORT: DEVELOPMENT PROBLEMS ASSOCIATED WITH THE BENDIX MODEL NT-D2 TURBINE-POWER-CONTROL-VALVE ACTUATOR. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 402p. Dep. NTIS $23.25.

The resolution of problems associated with the development of the Bendix Model NT-02 turbine-power-control-valve actuator for the XE-Prime engine is described. (JWR)

32050 (TID/SNA–832) MOCKUP AND SIMULATOR PROGRAM FOR NERVA e105-MOS02-W114f4a. Shoemaker, F. M.;

Burks, R. E.; Swain, R. K. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 22p. Dep. NTIS $4.25.

The need and requirements for engine simulators and mockups to be used in the NERVA engine program are defined. The items are described, their usages are detailed, and schedules are provided in relation to design, development, test stand activation, and engine testing. (auth)

32051 (TID/SNA-837) FLUIDIC CHAMBER PRESSURE CONTROL SUBSYSTEM FOR THE NERVA ENGINE, M100-PR3SA-W391. Third Semiannual Progress Report. Carroll, J. J.; Boyd, D. D.; Felsing, G. W.; Lewellen, W. S.; Mockenhaupt, J. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 219p. Dep. NTIS $14.00.

A basic flow schematic of the proposed fluidic subsystem for chamber-pressure control is shown in a diagram. This preliminary design identifies the basic flow paths for the energy sources and sinks necessary to maintain fluidic control of the basic subsystem. This concept and the engine design state points (pressure and temperature) are the performance criteria on which the design and testing are based. Design and development of the initial subsystem components have progressed to the degree that subsystem integration and initial prototype flight-engine design could be formulated for the complete hot-bleed fluidic chamber-pressure-control subsystem. Redirection of the engine cycle to the full-flow system will require more subscale subsystem tests to redefine the flight-engine design requirements. (auth)

32052 (TID/SNA-844) NERVA LOGISTICS SUPPORT PLAN, L003-SS-09205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 43p. Dep. NTIS $5.25.

The purpose of this plan is to identify the actions required for logistics support that ensure that the NERVA engine is maintained, provisioned, and transported in accordance with the requirements of the NERVA-engine program and the logistics provisions of SNPO-NPRD-1. This plan delineates the philosophy of the NERVA-engine logistics program and facilitates integration of the NERVA-engine program into the overall NERVA program. It applies to all phases of the NERVA program through mission completion. The plan conforms with the requirements of the SNPO-NPRD and reflects the output of the system engineering process. This data item also defines the NERVA contractor's responsibilities and scope, and the contributions of others needed to support the program. (auth)

32053 (TID/SNA-846) NRDS TEST CELL "A" NERVA TURBOPUMP 65mm BEARING TESTING FACILITY REQUIREMENTS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1971. Contract SNP-1. 24p. Dep. NTIS (US Sales Only) $4.25.

Test Cell "A" facility and special test equipment requirements are presented for the evaluation testing of LH_2 cooled 65mm rolling element bearings for the NERVA engine TPA. (See also TID/SNA-452 and 455.) (DLC)

32054 (TID/SNA-848) 75K NERVA MASS PROPERTIES STATUS REPORT. Talbott, K. E. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1969. 22p. Dep. NTIS $4.25.

The mass properties data for the 75K thrust level NERVA Reference Engine as of August 1969 are described. This engine is depicted on AGC Drawing 1136339 N/C, which was released 23 July 1969. The total engine dry weight of 29,102 pounds includes all components that Aerojet-General Corporation is responsible for plus the Nuclear Subsystem provided by Westinghouse Astronuclear Laboratories. The engine features two turbopumps plus an auxiliary compressor, a pressure vessel constructed of 7039 aluminum, a Cres 347 U-tube nozzle, a 100 to 1 expansion ratio Cres 347 skirt, and a 50 inch diameter disk shield. Some systems and component designs are not finalized at this time; consequently, the weights given are not necessarily the estimated weights of a specific system or component, but an allowance made for it. (auth)

32055 (TID/SNA-851) NERVA TELEOPERATOR STUDY PROGRAM. Oral Presentation of Final Report. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 10 Dec 1970. 39p. Dep. NTIS $5.00.

The objectives and requirements of a study program for developing an operational space teleoperator system are presented. (JWR)

32056 (TID/SNA-854) E-MAD REMOTE HANDLING SYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 24p. Dep. NTIS $4.25.

The system comprises three subsystems: overhead positioning subsystem, wall-mounted handling subsystem, and floor handling subsystem. NERVA engine disassembly operations are also described. (auth)

32057 (TID/SNA-858) FINAL XE-PRIME DOSIMETRY REPORT. Hertelendy, N. A.; Courtney, J. C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 218p. Dep. NTIS $14.00.

The results of radiation measurements made during the XE Prime engine tests are presented. (JWR)

32058 (TID/SNA-864) GIMBAL PIVOT ASSEMBLY. Bronner, H. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 72p. Dep. NTIS $6.75.

The gimbal pivot assembly which consists of a cruciform structure upon which are mounted four bearings contained within trunnions, provides a load-transmitting, universal joint function which provides the engine with sufficient degrees of freedom to meet the requirements for thrust vector control. The primary objective of these design studies was to examine the effect of materials properties on the size and stiffness of the gimbal pivot assembly. The specific effect of Young's modulus and material strength are discussed: In some parts a high yield strength is necessary to avoid a weight penalty. The nuclear, thermal, stress, weight, and dynamic analyses made for the gimbal pivot assembly as a unit or as a part of the engine assembly are discussed and referenced. Finally, fabrication methods are discussed briefly. It is concluded that the level of maturity presented does not provide a sound basis for design of this component but does, however, provide sufficient evidence to proceed with the analytical justification of the gimbal pivot concept described. (auth)

32059 (TID/SNA-871) MAINTAINABILITY, IN FLIGHT AND GROUND. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 70p. Dep. NTIS $6.50.

Maintenance requirements for use in reference design studies on the NERVA engine are presented. (JWR)

32060 (TID/SNA-880) PRELIMINARY EVALUATION OF A PROPOSED SCHEME FOR HYDROGEN RECOVERY FROM THE NERVA TURBOPUMP ASSEMBLY DEVELOPMENT PROGRAM. Booty, W. F. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 36p. Dep. NTIS 5.00.

This scheme utilizes a recuperator followed by a heater in the flow stream between the pump and turbine. The evaluation indicates that the scheme is theoretically feasible. The cost of the hydrogen saved is a maximum of $5.6 million, and it appears possible to construct a recovery system for less than this. There are also logistic advantages to a recovery system. (DLC)

32061 (TID/SNA-881) NERVA ENGINE/ETS-1 FACILITY COMPATIBILITY SAFETY STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 43p. Dep. NTIS $5.25.

The feasibility of safely conducting proposed engine test operations at engine test stand no. 1 (ETS-1) is evaluated. The known differences between the NERVA engine test series and previous NRX/XE test systems are compared for the purpose of uncovering new or greatly increased engine testing hazards relative to prior NRX/XE test analyses and experience. Potential safety problem areas are defined for subsequent more detailed analyses before conducting the NERVA engine test program. The 75K NERVA engine, the ETS-1 facility including planned modifications at the Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada, and the anticipated test program are described. Differences between the X-engine and the NERVA engine test systems, and the major safety problems associated with testing of the NERVA engine are discussed. (auth)

32062 (TID/SNA-883) ENGINEERING OPERATIONS REPORT: PHOTOELASTIC STRESS ANALYSIS METHODOLOGY AND APPLICATIONS TO NERVA STRUCTURES. Sampson, R. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1972. 38p. Dep. NTIS $5.00.

Photoelasticity theory is reviewed including model/prototype relations and materials behavior. The applications to NERVA components are discussed. (JWR)

32063 (TID/SNA-888) NERVA THIN SHELLS OF REVOLUTION COMPUTER METHODOLOGY: PETS. Nevenzel, J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 2 Jun 1972. 52p. Dep. NTIS $5.75.

The PETS computer structural analysis program for thin shells of revolution is described. The analytical method is derived in large part from the earlier AVCO Code developed by the AVCO Research and Advanced Development Division, Wilmington, Massachusetts. The present version is a variation of the "SAD" code developed by LASL primarily for the purpose of analyzing stresses, deflections and rotations in the pressure vessels of the Kiwi-B series nuclear rocket reactors. Also sought in this development were analytical methods adaptable to the structural optimization of future nuclear rocket system pressure vessels. Although based on

the theory of thin shells of revolution, the program may be used for any axisymmetric, axisymmetrically loaded, isotropic structure of revolution with radius to wall thickness ratio of approximately 5 or greater. As such, it was used to good advantage in design and analysis of pressure vessel and nozzle hardware in the Phoebus, NERVA Technology, and 75K NERVA engine programs. (auth)

32064 (TID/SNA-894) ENGINEERING OPERATIONS REPORT: NERVA MASS PROPERTIES COMPUTER METHODOLOGY. Hall, I. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Mar 1972. 260p. Dep. NTIS $16.00.

32065 (TID/SNA-903) ENGINEERING OPERATIONS REPORT: NERVA AXISYMMETRIC AND PLANE STRUCTURES FINITE ELEMENT STRESS ANALYSIS METHODOLOGY. Computer Programs E11401 and E11405. Rock, A. O. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 May 1972. 190p. Dep. NTIS $12.50.

Finite Element Computer Programs E11401 and E11405 were used extensively for the structural analysis of NERVA rocket engine components including nozzles, pressure vessels, and rotating machinery. Program E11401 is a finite element stress analysis for axisymmetric bodies of revolution and plane structures applicable to compressible solids with nonlinear material properties. Program E11405 is basically a modification of E11401 generalized to accept cylindrically anisotropic solids but with all plasticity calculations eliminated. A general discussion of the finite element method of analysis, including the basic equations and methods of solutions, along with examples of the application of the programs for the analysis of NERVA components is presented. (auth)

32066 (TID/SNA-904) ENGINEERING OPERATIONS REPORT: NERVA PIPING FLEXIBILITY ANALYSIS METHODOLOGY, MEL-21P. Bourne, W. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1972. 81p. Dep. NTIS $7.25.

MEL-21P is a computer program which uses tensor analysis methods to analyze the flexibility of multiple branch and closed-loop piping systems subject to thermal, concentrated, and uniform loadings including internal pressure effects. It is also applicable to cryogenic systems, beams, and indeterminate truss structures. A general discussion of the use of the program is presented along with examples of its application. The analytical and computational methods are too lengthy to be included. These methods and further details relating to the use of the program are discussed fully in the referenced User's Manual. (auth)

32067 (TID/SNA-905) ENGINEERING OPERATIONS REPORT: HOLOGRAPHIC INTERFEROMETRY METHODS APPLIED TO NERVA TPA STRUCTURES PROBLEMS. Sampson, R. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). 2 Jun 1972. 42p. Dep. NTIS $5.25.

The use of holographic interferometry techniques in determining the resonant vibration responses of blading and disks in the NERVA turbopump assembly is described. (JWR)

32068 (TID/SNA-906) ENGINEERING OPERATIONS REPORT: NERVA THIN SHELL FINITE ELEMENT STRESS ANALYSIS METHODOLOGY COMPUTER PROGRAM E11101. Rock, A. O. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1972. 97p. Dep. NTIS $8.00.

Aerojet Computer Program E11101, a finite element analysis of double curved shells, is described and some applications to the NERVA design effort are given. The analysis represents an arbitrary elastic and isotropic shell by a series of flat plate elements. This representation allows the analysis of the static small deflection behavior of thin shells subjected to arbitrary surface and boundary loads. The program is capable of handling shell intersection and folded plate problems. The double curved shell program was used in the analysis of the NERVA TPA hardware. The specific examples presented describe the applications to the turbine inlet housing and the first stage impeller blading. (auth)

32069 (TID/SNA-916) PROPOSAL NO. NRO 671869: CALCULATION OF IN-FLIGHT MODULAR NUCLEAR VEHICLE RADIATION. Folder 1, Technical Discussion. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Oct 1967. 42p. Dep. NTIS $5.25.

A proposed technical program for the calculation of the in-flight modular NERVA radiation environment is outlined. (JWR)

32070 (TID/SNA-917) RELIABILITY AND QUALITY ASSURANCE INFORMAL PROGRESS LETTER NO. 43A FOR FOURTH QUARTER, CY 1967 COVERING JULY, AUGUST, AND SEPTEMBER 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1967. 31p. Dep. NTIS $4.75.

Product assurance activities and quality control in the NERVA program are briefly reviewed. (JWR)

32071 (TID/SNA-918) NERVA PROGRAM: SAFETY CONSIDERATIONS RELATIVE TO CONSTRUCTION OF E/STS 2-3. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1967. 242p. Dep. NTIS $15.25.

Safety aspects peculiar to construction and use of nuclear rocket test stands 2 and 3 at the Nuclear Rocket Development Station, Nevada, are documented. Results of off-site radiologic l hazard studies are summarized and the effects of meteorological conditions during testing are discussed. Spacing of major components in the facility is analyzed and a design review of the control center, test stands, and the major facility systems is given. (JRD)

32072 (TID/SNA-923) DESIGN REQUIREMENT SHEETS: NERVA ENGINE, 75K FULL FLOW. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1970. 49p. Dep. NTIS $5.50.

Various design requirement sheets for the 75K, Full Flow NERVA engine are documented. They concern reactor cooldown, propellant pressurization, leakage limits, cleanliness, gas purities, turbopumps, reactor operations, emergency and malfunction response, etc. (LTN)

32073 (TID/SNA-925) DESIGN REQUIREMENT SHEET: ENGINE, NERVA, 75K, FULL FLOW. (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 Sep 1970. 110p. Dep. NTIS $8.50.

Various design requirement sheets for the 75K, Full Flow NERVA engine are documented (transportability requirements, instrumentation and controls, loads, test and checkout procedures, weight allocation, safety, human performance, etc). (LTN)

32074 (TID/SNA-926) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR BYPASS CONTROL MODULE VALVES. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 108p. Dep. NTIS $8.50.

A specification is presented which establishes the performance, design, test, and qualification requirements for equipment identified as bypass control valve and actuator, hereinafter referred to as the BCV assembly. It is a part of the contract end item described as Engine, NERVA, 75K, Full Flow and is listed as an Engineering Critical Component in detail specification CP-90290. (auth)

32075 (TID/SNA-927) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STRUCTURAL SUPPORT COOLANT MODULE VALVES. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 106p. Dep. NTIS $8.50.

A specification is presented which establishes the performance, design, test, and qualification requirements for equipment identified as the structural support coolant valve, hereinafter referred to as the SSCV. It is a part of the assembly described as structural support coolant assembly (SSCA) and is listed as an Engineering Critical Component in detail specification EC-677575. (auth)

32076 (TID/SNA-928) NERVA DETAIL SPECIFICATIONS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 265p. Dep. NTIS $16.25.

Detailed specifications (Revision A) of components of the 75K, Full Flow NERVA engine are provided as follows: propellant shutoff valve and actuator (EC-90117A); propellant lines (EC-90284A); nozzle assembly (EC-90196A); instrumentation and control system (EC-90214A); and the pressure vessel and closure (EC-90154A). (LTN)

32077 (TID/SNA-930) NERVA DETAIL SPECIFICATIONS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 270p. Dep. NTIS $16.50.

Detailed Specifications (Revision A) are provided for components of the 75K, Full Flow NERVA engine as follows: Propellant Shutoff Valve and Actuator (EC-90117A); Propellant Lines (EC-90284A); Nozzle Assembly (EC-90196A); Instrumentation and Control System (EC-90214A); and Pressure Vessel and Closure (EC-90154A). (LTN)

32078 (TID/SNA-932) NERVA DETAIL SPECIFICATIONS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 267p. Dep. NTIS $16.50.

Detailed specifications (Revision A) for components of the 75K, Full Flow NERVA engine are provided as follows: Turbopump Assembly (EC-90149A); Turbine Block Valve and Actuator (EC-90121A); Turbine Discharge Block Valve and Actuator (EC-90281A); and Pump Discharge Check Valves (EC-90246A). Some backup information is included. (LTN)

32079 (TID/SNA-933) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Bypass Control Valve. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 372p. Dep. NTIS $21.75.

Detailed specifications (Revision C) of components of the 75K, Full Flow NERVA engine are provided as follows: Bypass Control

Valve (EC-90122C). Several drafts and a final copy of the B revision are included. (LTN)

32080 (TID/SNA-941) NERVA NUCLEAR SUBSYSTEM. Part I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1971. 236p. Dep. NTIS $15.00.

The design requirements of the Nuclear Subsystem (NSS) of the 75K, Full Flow NERVA engine are provided as follows: NERVA Nuclear Subsystem (CP-677555A), (CP-677555/20A), (CP-677555B), (CP-677555/10B), and (CP-677555/20B). Appendix 10 refers to a Ground Test NSS and Appendix 20 refers to a Composite Core NSS. The specifications are extensive, complex and detailed. A Specification Traceability Matrix and Verification Plan is included to provide verification and traceability of the requirements. (LTN)

32081 (TID/SNA-943) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR NUCLEAR SUBSYSTEM SUPPORT PLATE AND PLENA AND INTERNAL SHIELD. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 131p. Dep. NTIS $9.75.

32082 (TID/SNA-944) NUCLEAR SUBSYSTEM COMPONENT SPECIFICATIONS. Book 2. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 167p. Dep. NTIS $11.50.

Detailed specifications are provided for components of the Nuclear Subsystem of the 75K, Full Flow NERVA engine as follows: Nuclear Subsystem Instrumentation (EC-677565); Structural Support Coolant Assembly (EC-677575); Structural Support Coolant Valve Actuator (EC-677576); and the Control Drum Drive Assembly (EC-677585). (LTN)

32083 (TID/SNA-946) NERVA COMPONENT SPECIFICATIONS. Preliminary Section 4. Book 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1970. 209p. Dep. NTIS $13.50.

Preliminary Quality Assurance provisions are provided (which will be integrated with other parts of the specifications at a later date) for various components of the 75K, Full Flow NERVA engine as follows: Propellant Feed System (EC-90218), Turbopump Assembly (EC-90149), Propellant Shutoff Valve and Actuator (EC-90117), Bypass Control Valve and Actuator (EC-90122), Bypass Block Valve and Actuator (EC-90257), Turbine Block Valve and Actuator (EC-90121), Pump Discharge Check Valve (EC-90246), Cooldown Supply Control Valve and Actuator (EC-90258), Cooldown Shutoff Valve and Actuator (EC-90276), Turbine Discharge Block Valve and Actuator (EC-90281), Structural Support Block Valve and Actuator (EC-90261), Turbine Throttle Valve and Actuator (EC-90283), Stage Tank Pressurization Line and Check Valve (EC-90263), Engine Purge Unit (EC-90264), Propellant lines (DS-90284), Nozzle Assembly Subsystem (EC-90151), Nozzle (DS-90196), Nozzle Extension (DS-90176), Thrust Structure Subsystem (EC-90152), Upper Thrust Structure (DS-90267), Lower Thrust Structure (DS-90269), Gimbal Assembly Subsystem (EC-90244), Gimbal Actuator (DS-90251), Pressure Vessel and Closure System (EC-90154), and Structural Support Coolant Valve (EC-90192). (LTN)

32084 (TID/SNA-949) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Structural Support Coolant Valve. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 8 Jul 1970. 220p. Dep. NTIS $14.00.

Detailed specifications are provided for components of the 75K, Full Flow engine as follows: Structural Support Coolant Valve (EC-90192), (EC-90192/10), (EC-90192/20); External Shield Subsystem (EC-90243), (EC-90243/10), (EC-90243/20); Gimbal Assembly Subsystem (EC-90244), (EC-90244/10), (EC-90244/20); Gimbal Actuator (DS-90251); and the Pressure Vessel and Closure Subsystem (EC-90154), (EC-90154/10), (EC-90154/20). Appendix 10 in the above refers to those specifications which are different in the Ground Test Reactor and Appendix 20 refers to specifications which are different in the Composite Core reactor. (LTN)

32085 (TID/SNA-951) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Bypass Valves and Actuators. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 109p. Dep. NTIS $8.50.

Revised specifications are provided for certain valves and actuators of the 75K, Full Flow NERVA engine (Bypass Control Valve and Actuator (EC-90122A) and Bypass Block Valve and Actuator (EC-90257A)). (LTN)

32086 (TID/SNA-952) NERVA SPECIFICATIONS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 206p. Dep. NTIS $13.50.

Revised specifications are provided for certain valves and actuators of the 75K, Full Flow NERVA engine (Cooldown Supply Control Valve and Actuator (EC-90258A), Cooldown Shutoff Valve and Actuator (EC-9026A), Structural Support Coolant Valve (EC-90192A), and the Structural Support Block Valve and Actuator (EC-90261A)). The functional characteristics and requirements are specified. (LTN)

32087 (TID/SNA-953) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Upper and Lower Thrust Structures, Gimbal Actuator, Gimbal Pivot and External Shield. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 101p. Dep. NTIS $8.25.

Revised specifications are provided for certain mechanical structures of the 75K, Full Flow NERVA engine (Upper Thrust Structure (EC-90267A), Lower Thrust Structure (EC-90269A), Gimbal Actuator (EC-90251A), Gimbal Pivot (EC-90299A) and the External Shield (EC-90243A)). (LTN)

32088 (TID/SNA-954) COMPONENT SPECIFICATIONS: PUMP DISCHARGE CONTROL MODULE. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Apr 1971. 112p. Dep. NTIS $8.75.

Detailed specifications (A revision) are provided for components of the 75K, Full Flow Engine as follows: Pump Discharge Control Valve and Actuator (EC-90280A); and the Pump Discharge Block Valve and Actuator (EC-90282A). (LTN)

32089 (TID/SNA-955) NERVA DETAIL SPECIFICATIONS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 265p. Dep. NTIS $16.25.

Detailed Specifications (Revision A) are provided for the 75K, Full Flow NERVA engine as follows: Turbopump Assembly (EC-90149A); Turbine Block Valve and Actuator (EC-90121A); Turbine Discharge Block Valve and Actuator (EC-90281A); and Pump Discharge Check Valves and Actuators (EC-90246A). (LTN)

32090 (TID/SNA-957) N.E.T.A.P. (NUCLEAR ENGINE TRANSIENT ANALYSIS PROGRAM). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 26 Feb 1971. 403p. Dep. NTIS $23.25.

The present status of the transient-engine-simulation program (Program 31201) is described. The development of the equations together with the logic used in their solution is presented. The basic aim was to provide a mathematical model of the various NERVA engine systems that could be used to study the performance and operating characteristics of these systems and thus provide valuable design information. The present program is the result of several years of development effort and provides the desired versatility. Any of the nuclear engine systems now under study can be modeled by proper choice of input. In addition, the arrangement of the program into many short subroutines provides for easy modifications and for the possibility of completely replacing portions of the program with an alternative calculation procedure easily and quickly. The program is a finite-difference, explicit-solution, digital-computer program that calculates solid temperature, liquid temperature, and pressure distribution as functions of distance and time throughout the engine system. Separate analyses of the turbopump, structural support system, reflector, shield, core, nozzle, etc., and the various tanks and lines are combined to represent the transient performance of the complete engine. The turbopump-assembly model consists primarily of an energy balance, including an energy-storage term to account for the angular energy of the rotating machinery. The representation has been expanded to handle either a single- or two-spool turbopump. (auth)

32091 (TID/SNA-958) TRANSMITTAL OF COMPLETED STRUCTURAL ANALYSES NOT PREVIOUSLY REPORTED TO TPA DESIGN SECTION IN WRITTEN FORM. Pineda, U. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 24 Apr 1972. 182p. Dep. NTIS $12.25.

Stress analyses of 23 parts of the NERVA Turbopump Assembly are presented in handwritten form. (LTN)

32092 (TID/SNA-959) ENGINEERING OPERATIONS REPORT: TURBOPUMP BLADE RELIABILITY IN HIGH FREQUENCY FATIGUE. Lorenc, S. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Nov 1971. 83p. Dep. NTIS $7.25.

A preliminary analysis was conducted on the turbine and inducer reliability for high cycle fatigue. A simple reliability model was formulated based on interference between the blade cyclic stress ($\bar{S}_s$, σ_{S_s}) and the material fatigue strength ($\bar{S}_r$, σ_{S_r}). All variables were assumed to be independent and normally distributed and their variances were determined using propagation of variance technique. Only the first fundamental mode of vibration was considered. Satisfactory reliability was estimated. High predicted blade reliabilities could be inferred from the following considerations: 1. Low steady state blade stresses, which are the result of the selected engine cycle requiring low turbine inlet temperature and relatively low TPA rotational speed dictated by the bearing life

and inducer performance requirements. 2. Low level of cyclic stresses, which were achieved by designing relatively thick blade profiles, and thereby removing the first fundamental natural frequencies from the blade operating range. (auth)

32093 (TID/SNA-960) JUSTIFICATION OF TURBOPUMP DESIGN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1970. 300p. Dep. NTIS $18.00.

This report gives the preliminary design effort on the NERVA TPA from May 1 to Sep. 1, 1970. (Structural and thermal analyses are not covered.) Design requirements are discussed with a summary of TPA Trade Study from which the selected concept was derived. Both the fluid dynamic and mechanical designs are described in detail. (DLC)

32094 (TID/SNA-964) NERVA THREE-STAGE AXIAL FLOW TURBINE PERFORMANCE AND AERODYNAMIC ANALYSIS REFERENCE TURBOPUMP. Kirk, K. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 23 Jul 1968. 149p. Dep. NTIS $10.50.

The three-stage axial flow turbine is the result of an extensive turbopump parametric analysis, including turbopump structural and reliability considerations, leading to the following turbine requirements: shaft horsepower = 7,280; turbine inlet temperature = 1,660°R; turbine inlet pressure = 305 psia; turbine pressure ratio = 7.01 (total to static); and rotative speed = 19,000 rpm. The basic design philosophy maintained for this turbine and those which preceded it during the parametric study is given. Performance analysis for the turbine centers around the method of predicting losses for both the blading and associated inlet and exhaust ducting. The loss analysis selected for the blading is given and includes these several assumptions which are listed. (1) One-dimensional flow at the mean radius. (2) Adiabatic flow through static components, i.e., manifolds and nozzles. (3) Blading losses may be satisfactorily predicted on the basis of (a) Reynolds number; (b) nozzle exit angle; (c) average kinetic energy level of the stage; (d) rotor tip clearance. Losses in the inlet manifold and exhaust collector are based on a total pressure loss coefficient. Utilizing the required shaft power and assumed turbine flow rate (which eventually must satisfy the pressure ratio requirement), the specific work requirement of the turbine is determined and is distributed to each individual stage in a manner consistent with the basic design philosophy. (auth)

32095 (TID/SNA-972) PRELIMINARY MEASUREMENT REQUIREMENTS LIST FOR THE NERVA OPERATIONAL FLIGHT ENGINE (1137400E), C101-CP090290A-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 29 Oct 1971. 53p. Dep. NTIS $5.75.

A list of items which need to be measured in the NERVA flight model is provided. The list was prepared by members of 4 disciplines and reviewed by all groups. (auth)

32096 (TID/SNA-973) NERVA TURBOPUMP ASSEMBLY. Volume III. Thermal and Structural Analysis. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 24 Sep 1971. 252p. Dep. NTIS $15.75.

Pump chilldown and detailed sub-component steady-state and transient thermal analyses were performed for the Dwg. No. 1118101 Change B configuration in order to evaluate and assess various methods of chilling the turbopump prior to startup, and to provide component temperature distributions required for stress and deformation analysis. It was necessary to construct an analytical model which would simultaneously perform operations on the working fluid as well as the solid material. The CINDA-3G computer program was selected for modeling the TPA because it has the capability of computing heat transfer coefficients, fluid flow rates and fluid conditions (vapor quality and enthalpy) between each thermal transient computation of the solid nodes. Since subcomponent transient temperature distributions were generated by the CINDA-3G pump chilldown model, these results are logically included as part of the subcomponent transient thermal analyses. The parts of the turbopump not included in the chilldown model were modeled using the Finite Element Codes, E12401 and E12202. Steady-state and transient subcomponent analyses were performed for the normal dual pump mode of operation using worst-case boundary conditions. The analyses assumed space operating conditions with nuclear heating but neglected solar heating. For stress analysis interface loads are given separately for thermal, pressure and inertia loading components. Thermal loads are based on steady state operating temperature from NETAP state point data, 1137400 "C" composite core, nominal normal start of life. Pressure loads are from the same source. The component loads due to pressure are external system equilibrium loads only. Stresses due to these loads must be superimposed on the pressure stresses required to satisfy component internal equilibrium. Inertia loads are given separately for +8.5 g's acting statically in each of the three principal axes of the PFS (X, V, W). The static analysis at the 8.5 g level serve to provide approximate dynamic loads for design use until a dynamic response analysis of the system can be accomplished. In applying these loads in component stress analyses, thermal stresses should be considered secondary and those due to pressure and inertia are to be considered primary (Reference SNPO-C-1). (auth)

32097 (TID/SNA-974) ENGINEERING OPERATIONS REPORT: PROPULSION MODULE STUDY. Project 110. Work Statement Paragraph 3.1. Gilles, W. P.; Unmack, K. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1972. 175p. Dep. NTIS $11.75.

The propulsion module concept consists of NERVA, a propellant run tank, and associated subsystems as would be required for propellant transfer, remote docking, tank pressurization and attitude control. A study was directed toward integration of the current NERVA 1137400E configuration with the propellant run tank in order to reduce engine problems. Prime consideration was given to providing a less hostile radiation environment for the electronics modules, reducing the remote electrical and mechanical interface complexities between the engine and tank, and to determine a location for the engine cooldown valve module. The study evaluated the effect of this integration on the engine in the following areas: Electronics location; interface design-electrical, fluid, and structural; engine external disk shield requirements; gimbal location; and overall engine configuration. The results involve some assumptions about interface design and whether maintenance is manual, semi-remote or remote, so they are rather involved. There is no advantage and there are some disadvantages in locating the electronics on the engine. Many other conclusions and recommendations are given. (auth)

32098 (TID/SNA-975) NERVA TURBOPUMP ASSEMBLY. Volume IV. Structural Analysis, Reliability and Safety, and Subcomponent Feasibility Test Results. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 432p. Dep. NTIS $24.75.

The purpose of Stress Analysis is to substantiate the structural integrity of the turbopump assembly, its components and subcomponents. This substantiation is accomplished by isolating the part in question and, by consideration of boundary conditions, applied loads and reactions, establishing the part as a free-body in static equilibrium. Internal loads and stresses may be calculated at any point by the application of classical, theoretical techniques. Critical stresses are then compared to the material allowables, either the conventional mechanical properties or critical stress intensities from fracture mechanics, as appropriate, and the margins of safety calculated. Factors of safety to be used, as well as all other structural design and analysis criteria are from Reference 1, NASA Report SNPO-C-1, "NERVA Program Structural Design Requirements." In some cases, fatigue life, high or low cycle, will be the governing criterion rather than just the ratio of strength to static stress. Here, too, consideration must be given the choice of appropriate technique, i.e., whether conventional S-N (stress-cycles to failure) curves or fracture mechanics crack propagation theory should be used. Since the TPA consists of high speed rotating machinery with many critical, close clearances relative to stationary parts, accurate deflection determinations are of vital importance and part modelling must be done with as much precision as possible. The reliability effort involved a failure mode analysis, reliability allocation to the part level and selected probabilistic analysis. Clearances were small and critical; blade fatigue failure was not serious due to relatively low blade loading. The reliability estimates were mostly predictions, since very few data were available. Turbine blades, impellers and bearings were subjected to considerable analysis and appreciable testing. Bearing loads were quite high, particularly during startup and initial operations, and ball and retainer wear was appreciable. (LTN)

32099 (TID/SNA-978) ENGINEERING OPERATIONS REPORT: RADIATION AND SHIELDING ANALYSIS FOR NUCLEAR PROPULSION MODULE STUDY. Project 110, Work Statement Paragraph 7. Warman, E. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 3 Dec 1971. 47p. Dep. NTIS $5.50.

The payload radiation levels were analyzed for the Cruciform Class 3 reuseable nuclear shuttle (RNS) configuration. From these analyses, a reference external engine shield was determined and shield weights were estimated for a variety of conditions. With no external shield the tank top dose exceeds the 10 Rem limitation. Attempting to solve the nuclear stage biological shielding problem by increasing internal shielding above what is necessary for unmanned missions is costly in weight for the unmanned missions and totally inflexible for alternative stage configurations. The results of the current study show a minimum requirement of 2,000 lb external shielding plus a 2,000 lb internal shield, with nominal leakage and a 10 Rem tank top dose constraint. This

minimum assumes a 7,500 lb LH_2 residual level at the end of power operation. A 3,500 lb external shield is required for a 3,500 lb LH_2 residual level, with nominal leakage. With specification extreme PVARA radiation leakage the external shield requirement is 4,000 or 5,000 lb respectively for the 7,500 or 3,500 lb LH_2 residual conditions. In summary, an external shield requirement does exist for the propulsion module concept when used in conjunction with either of the above propellant module configurations. A reference external engine shield is therefore recommended for the Cruciform Class 3 RNS configuration which should be 42 inches in radius and weigh 4,000 lbs. This shield is described. (auth)

32100 (TID/SNA-989) NERVA PERFORMANCE CAPABILITIES WITH "MINI" TANK PROPULSION MODULE (REVISION A). Lavenda, T. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 3 Dec 1971. 10p. Dep. NTIS $10.00.

For unmanned space flights requiring the lower energies it is calculated that chemical vehicle performance is superior to NERVA. The latter is superior for extremely high energy missions. For a specified mission the payload can be increased by adding propellant, increasing the specific inpulse or decreasing the engine or stage weight. For the lower energy missions, a reduction in engine (or stage inert weight) becomes most important in improving NERVA performance and its overall competitive range of mission applications as compared to the chemical O_2/H_2 system. (LTN)

32101 (TID/SNA-990) PRELIMINARY COMPUTER REQUIREMENTS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 32p. Dep. NTIS $4.75.

The preliminary requirements for a computer for NERVA are outlined: Word length, 32 bits; memory size, 115,000 words; and operational speed, 1.1×10^6 operational steps/s. The operational requirements the computer is expected to take care of are listed. The location of the computer is tentatively specified and it is concluded that some maintenance will be needed even though a high reliability is specified. (auth)

32102 (TID/SNA-992) ENGINEERING OPERATIONS REPORT: ADDENDUM TO NERVA TURBOPUMP DESIGN REPORT. Project 121. Bair, E. K.; Kimura, L. A.; Lorenc, S. A.; Mironenko, G.; Thomas, E. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1972. 455p. Dep. NTIS $25.75.

An addendum to the NERVA Turbopump Design Report (N8300R: 71-076) documents the design effort performed on the prototype NERVA Turbopump (Layout Drawing No. 1118101 "C") between the time the design report was issued and the cancellation of the NERVA program. The work involved: Fluid Design and Performance, Thermal Analysis, Structural Analysis, and Reliability and Safety. Turbine efficiency was corrected for the effect of the first stage stator leakage. A revised efficiency plot is given. A statistical error technique was developed and used for steady state thermal analyses of the main turbopump components. A partial derivative method was applied to the existing finite-element models considering thermal conductivity, nuclear heating rate, convective film coefficients and fluid temperature as random variables. The structural analysis is updated and includes additional analyses. All components analyzed were found structurally adequate. Probabilistic analysis involves updating of the TPA failure mode analysis. It also contains the development of a reliability block diagram relating part or failure mechanism to six basic TPA failure modes and completion of several part or mechanism reliability estimates. (auth)

32103 (TID/SNA-1012) DATA HANDLING PLAN FOR THE INTERIM PERIOD THROUGH SEPTEMBER 1972. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 14 May 1971. 23p. Dep. NTIS $4.25.

Plans are made for data acquisition, handling and processing in connection with bearing testing, turbopump development, LH_2 pump components and scrubber development (for removing fission products from effluent gases). Plans are for 18 months duration from May, 1971. (LTN)

32104 (TID/SNA-1020) PRE-IRRADIATION ANALYSIS OF NRX-A2 CABLE. Fluke, G. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Jan 1964. 13p. Dep. NTIS $4.00.

The available test information on NRX-A2 cable was summarized and the expected temperatures caused by gamma heating were computed. Present estimates of radiant heating by the plume indicate this is a severe problem and the cables will not withstand the heat. Restrictions placed on use of the cable for various radiation fields are given. It should be attached on its flat side to a cold surface to provide a maximum conductor area and unsupported lengths or "pigtails" should not be made in radiation levels greater than 4.7×10^9 to 1.5×10^{10} ergs/gram(C)-hr, depending upon cable size. These restrictions are based on assumptions stated within the report and on the premise that something will be done about the plume heat. The total dosage limitation is based on the organic H-film (polyimides) that is present. Its radiation threshold is approximately 10^{11} ergs/gram(C) and 10^{16} nvt fast neutrons. (auth)

32105 (TID/SNA-1023) STEADY STATE TEMPERATURE PROFILE OF NRX-A1 ALUMINUM PRESSURE VESSEL ASSEMBLY. Thomas, E. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Apr 1963. 30p. Dep. NTIS $4.50.

The objective of this analysis was to provide a steady state thermal profile of the NRX-A1 aluminum pressure vessel, when operating under expected full power NRX test conditions, to be used as input for a detailed stress analysis. Heat input was assumed to be from nuclear internal heat generation. Cooling was assumed to be from conduction and convection. Thermal conductivity was made to vary with material temperature so that at each iteration the conductivity of each node was a function of the calculated temperature. Convective film coefficients were calculated using Thompson's "B" correlation with fluid conditions from the flow schematic contained in AGC No. 7386 in accordance with Azusa Project Directive 168. Based upon the results of this analysis there is no problem of excessive component heating. The analysis of the forward flange when operating under full reactor power with a dummy shield indicates that there is no need for bolt cooling. (auth)

32106 (TID/SNA-1061) NERVA ENGINE MAIN TANK PRESSURIZATION ANALYSIS: VAPOR PHASE. Smith, L. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Mar 1964. 92p. Dep. NTIS $7.75.

A system of quasi-linear partial differential equations was developed that describes the transient thermal response in the ullage volume of a propellant tank during pressurization and liquid expulsion. The ullage vapor was assumed to be a thermally stratified, compressible gas. Equations in differential form, for the vapor energy and continuity equations as well as the tank wall energy equation, were approximated by finite differences and programmed on an IBM 7094. The ultimate purpose of the analysis was to determine the pressurant mass flow requirements to propellant tanks that are similar to the RIFT tank. Several computer runs were made that confirmed that the thermal and mathematical model give reasonable agreement with experimental data. Predicted and experimental data gave agreement within 10% for the transient ullage vapor temperature response, indicating that similar agreement would be obtained for the mass flow requirements. (auth)

32107 (TID/SNA-1062) NERVA SPECIFICATIONS, JULY–AUGUST 1970. Book 3. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 212p. Dep. NTIS $13.75.

Design requirement specifications are provided for components of the Propellant Feed System of the 75K, Full Flow NERVA engine as follows: Cooldown Supply Control Valve and Actuator (EC-90258); Cooldown Shutoff Valve and Actuator (EC-90276); Turbine Discharge Block Valve and Actuator (EC-90281); and the Structural Support Block Valve and Actuator (EC-90261). (LTN)

32108 (TID/SNA-1063) NERVA SPECIFICATIONS. Book 2. July–August 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 206p. Dep. NTIS $13.50.

Specification requirements for parts of the Propellant Feed System (EC-90218) of the 75K, Full Flow NERVA engine are presented as follows: Turbine Block Valve and Actuator (EC-90121), Pump Discharge Check Valves (EC-90246), Pump Discharge Valve and Actuator (EC-90280), and Pump Discharge Block Valve and Actuator (EC-90282). (LTN)

32109 (TID/SNA-1064) NERVA DETAIL SPECIFICATION. Part 1. Performance/Design and Qualification Requirements for Propellant Feed Subsystem. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Jul 1970. 376p. Dep. NTIS $22.00.

Specification requirements are provided for the Propellant Feed Subsystem (EC-90218) of the 75K, Full Flow NERVA engine and of some of its components as follows: Turbopump Assembly (EC-90149), Propellant Shutoff Valve and Actuator (EC-90117), Bypass Control Valve and Actuator (EC-90122) and the Bypass Block Valve and Actuator (EC-90257). (LTN)

32110 (TID/SNA-1066) NERVA SPECIFICATIONS, JULY–AUGUST 1970. Book 5. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 193p. Dep. NTIS $12.75.

Detailed specifications of components of the 75K, Full Flow NERVA engine are provided as follows: Nozzle Assembly System (EC-90151); Nozzle (DS-90196); Nozzle Extension (DS-90176); Thrust Structure Subsystem (EC-90152); Upper Thrust Structure (DS-90267); and Lower Thrust Structure (DS-90269). (LTN)

32111 (TID/SNA-1068) NERVA SPECIFICATIONS. Book 4. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 116p. Dep. NTIS $9.00.

Specifications are provided for structural components of the 75 K, Full Flow NERVA engine as follows: Thrust Structure Subsystem (EC-90152), Upper Thrust Structure (DS-90267), Middle Thrust Structure (DS-90268), Lower Thrust Structure (DS-90269), Shield Spacer (DS-90270), External Shield Subsystem (EC-90243), Gimbal Assembly Subsystem (EC-90244), Gimbal Actuator (DS-90251), pressure vessel and Closure Subsystem (EC-90154) and Structural Support Coolant Valve (EC-90192). (LTN)

32112 (TID/SNA-1069) NERVA SPECIFICATIONS. Book 3. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 143p. Dep. NTIS $10.25.

Detailed design specification requirements are provided for components of the 75K, Full Flow NERVA engine as follows: Destruct Subsystem (EC-90242); Nozzle Assembly Subsystem (EC-90151); Nozzle (DS-90196); Nozzle Skirt Extension (DS-90176); Instrumentation and Control Subsystem (EC-90214); Electronic, Power, Instrumentation and Control (EC-90155); Wiring Harness (EC-90179); Engine Instrumentation (EC-90177); and Electrical Power Source (EC-90216). (LTN)

32113 (TID/SNA-1070) NERVA SPECIFICATIONS. Book 2. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 124p. Dep. NTIS $9.25.

Detailed specifications of components of the 75K, Full Flow NERVA engine are provided as follows: Turbopump Assembly (EC-90149); Propellant Shutoff Valve and Actuator (EC-90117); Turbine Block Valve and Actuator (EC-90121); Pump Discharge Check Valve and Actuator (EC-90246); Coolant Supply Control Valve and Actuator (EC-90258); Coolant Supply Check Valve (EC-90259); Turbine Discharge Check Valve (EC-90260); Structural Support Valve and Actuator (EC-90261); and Engine Purge Unit (EC-90264). (LTN)

32114 (TID/SNA-1071) NERVA SPECIFICATIONS. Book 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 194p. Dep. NTIS $12.75.

Specifications are provided for the 75 K, Full Flow NERVA engine and components as follows: Engine, NERVA, 75K, Full Flow (CP-90290); Change Sheets (February 1970 change sheets); Propellant Feed Subsystem (EC-90218); Bypass Block Valve and Actuator (EC-90257); and Bypass Control Valve and Actuator (EC-90122). (LTN)

32115 (TID/SNA-1073) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Turbopump Assembly. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 382p. Dep. NTIS $22.25.

Detailed specifications (Revision C) are provided for the Turbopump Assembly of the 75K, Full Flow NERVA Engine as follows: Turbopump Assembly (EC-90149C) and 4 items of (EC-90149B) labelled Draft #1, Draft #2, Approval Copy and Submittal Copy. (LTN)

32116 (TID/SNA-1075) NERVA DETAIL SPECIFICATION. Part 1. Performance/Design and Qualification Requirements for Upper Thrust Structure. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 17 Jan 1972. 39p. Dep. NTIS $5.00.

Revised detail specifications are provided for the Upper Thrust Structure (EC-90267B) of the 75K, Full Flow NERVA engine. (LTN)

32117 (TID/SNA-1079) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Pressure Vessel and Closure. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 346p. Dep. NTIS $20.50.

Revised specifications, EC-90154C, are given for the pressure vessel and closure of the 75K, Full Flow, NERVA engine. Article contains 2 preliminary drafts of the B revision, the final B revision, the final B revision and the C revision of this specification. (LTN)

32118 (TID/SNA-1080) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Nozzle Assembly. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 145p. Dep. NTIS $10.25.

32119 (TID/SNA-1089) ENGINEERING OPERATIONS REPORT: NERVA MISSION ANALYSIS CODES, CY1972. Engine Activity No. 11. Lavenda, T. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1972. 36p. Dep. NTIS $5.00.

Digital computer programs used to numerically simulate NERVA engine and nuclear vehicle mission applications are described. These computer programs provide engine performance, trajectory simulation, vehicle mass properties, propellant tank pressurization and thermal environment, and a system cost effectiveness model. In accordance with the governmental directive for the disposition of NERVA documentation, program descriptions, users manuals, program listings, and source program card decks have been supplied for forewarding to a Federal Records Center. These programs cover a period of development and utilization from CY 1969 through CY 1972. Some typical results are documented in references given and a few programs are described briefly. (auth)

32120 (TID/SNA-1092) PROPULSION MODULE STUDY. Engineering Operations Report. Breindel, B.; Gilles, W. P.; Unmack, K. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1972. Contract SNP-1. 156p. Dep. NTIS $11.00.

A study was made to determine the potential for modifying the 1137400E NERVA engine in order to obtain an improved engine configuration based upon integrating the NERVA with the Class 3 Reusable Nuclear Shuttle (RNS) vehicle. The Class 3 RNS concept and feasibility analysis is discussed in Reference (a) and the Class 3 RNS arrangement is shown. The Propulsion Module concept consists of NERVA, a propellant run tank, engine/run tank and Propulsion Module/vehicle mating structure and LH_2 propellant management subsystems. The Propulsion Module is designed to be deliverable by Earth Orbital Shuttle (EOS) for subsequent mating with the remaining LH_2 Propellant Modules and Command and Control Module to form a mission ready RNS vehicle. The engine design characteristics and potential modifications considered and presented were with respect to electronics location, interface design, engine external disk shield requirements, gimbal location, cooldown valve module location and overall engine configuration. (auth)

32121 (TID/SNA-1093) ENGINE INTEGRATION. Project 110f-Paragraph 4. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 23 Mar 1972. 485p. Dep. NTIS $27.25.

The results of NERVA engine studies are reported. Certain characteristics of performance (loss coefficients, leakage rates, response, pump stall, line size, etc.) were studied and defined and ultimately some ended up as design requirements. The NERVA engine can be operated throughout its required range, but areas of startup, shutdown and cooldown require more analytical and test studies to determine the simplest and most efficient method of operation. For example, as a result of TPA inducer test results, changes were made to obtain more information on engine conditioning. Improved chilldown methods were developed for achieving the low temperatures required for startup with a minimum use of hydrogen. (LTN)

32122 (TID/SNA-1094) ENGINEERING OPERATIONS REPORT: NERVA ENGINE OPERATING DESCRIPTION. Conn, K. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1972. 42p. Dep. NTIS $5.25.

The latest operating description assumed for a standard operating cycle of the NERVA flight engine is presented. It is based on the 1137400 Revision E engine system with the exception of the assumptions that the cooldown line junction is relocated upstream of the structural support valve module and that the pump discharge check valves are redesigned to require a zero or negative cracking pressure. The operating description covers the engine operating phases from pre-start through cooldown and post operations. A combination of low flow and power chill techniques are assumed for turbopump chilldown during the engine conditioning phase. The recommended shutdown concepts and procedures from the throttled hold point are designed to obtain the most efficient utilization of propellant. This operating description provides the current best assumptions of how feasible and efficient operation of the basic 1137400 Revision E engine system can be obtained. (auth)

32123 (TID/SNA-1097) ENGINEERING OPERATIONS REPORT: 75K NERVA THERMAL AND FLUID FLOW ANALYSIS. Thompson, W. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 19 May 1972. 313p. Dep. NTIS $18.75.

Results are presented of analyses performed to evaluate various aspects of the NERVA engine performance in space. The analyses conducted may be divided into two broad categories: (1) the engine system in space considering thermal characteristics resulting from solar and albedo heating as influenced by system materials and coatings, and (2) the propellant feed system analyzed as in (1) but also including detailed chilldown studies of the turbopump assembly (TPA). Solar heating at 0.72 astronomical units (AU) was found to represent the most severe design condition. Aluminum components without special emissivity-enhancement treatment and/or other protective measures attain metal temperatures exceeding the assumed service temperature of 300°F. However, such coatings on an engine kept fully in the shade on a Mars mission result after 350 days in a reactor temperature of 42°R

for a never-fired engine and 270°R when nuclear decay heating is considered. A coated but uninsulated TPA subjected to solar heating at 1 AU following TPA operation reaches temperatures of 270 to 300°R after 10 hours solar exposure; with insulation this range becomes 92 to 195°R at 10 hours. Three TPA chill-down concepts were considered (powered, low flow plus powered, and auxiliary pump); all three were found capable of removing heat from the assembly. (auth)

32124 (TID/SNA-1099) ENGINEERING OPERATIONS REPORT: INTERFACE CONTROL AND MRL PHASEDOWN REPORT. Smith, J. L.; Froelion, R. W. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1972. 16p. Dep. NTIS $4.00.

A plan for engine interface control activities to coordinate engine and component design activities in conformance with the 1137400E flight engine baseline is presented. Specific activities will include: Maintaining interface control drawings (IDS's) and publishing a flight engine Data Item E-106 consistent with the level of flight engine, flight engine component, stage, facilities and aerospace ground equipment design maturity available eight weeks prior to data item submittal to SNSO-C; and maintaining the preliminary Operational Flight Engine Measurement Requirements List (MRL) consistent with design requirements, the flight engine configuration and an allocated minimum measurement channel quantity. Work will be performed and documented in accordance with Data Item Description C-101. (auth)

32125 (TID/SNA-1100) STATUS REPORT ON ENGINE SYSTEMS DESIGN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 33p. Dep. NTIS $4.75.

The status of several NERVA Engine Systems Design Projects (subprojects of 110) at the termination of the contract in May 1972 is reported. Recommendations and backup information are given in some cases. (LTN)

32126 (TID/SNA-1103) ENGINEERING OPERATIONS REPORT: SHIELDING REQUIREMENTS FOR RNS NUCLEAR PROPULSION MODULE. Project 110, Work Statement Paragraph 7. Warman, E. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 14 Jul 1971. 16p. Dep. NTIS $4.00.

The first phase of evaluation of the radiation analysis and shielding requirements for a modular Reusable Nuclear Shuttle (RNS) configuration employing a Propulsion Module is reported. This phase is based on extrapolations from previous ANSC computer analyses involving the McDonnell Douglas small propellant tank. The second phase is to include a computer analysis to confirm the extrapolations. In summary, it was found that an external engine disk shield is required for the modular RNS. The weight of this shield depends on the dose criterion and amount of residual LH_2 for cooldown. (auth)

32127 (TID/SNA-1105) ENGINEERING OPERATIONS REPORT: HIGH PRESSURE BELLOWS ELIMINATION. (Response to E/CDSR Action Item 2). Oates, J. H. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 80p. Dep. NTIS $7.00.

An engineering analysis was conducted to eliminate the use of bellows in the NERVA Pump Discharge Line, Cooldown Line, and Stage Tank Pressurization Line. One important feature of the analysis is that a major portion of the Propellant Feed System is considered as a flexible entity. The flexibility of this system is used to allow sufficient line end-point deflections and rotations to reduce interface loads and line stresses to acceptable levels, thus eliminating the need for bellows. (HDR)

32128 (TID/SNA-1106) NERVA THRUST STRUCTURES. Component Design Report (Interim), N8600R: 71-013. Bronner, H. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 59p. Dep. NTIS $6.00.

The concept design and analysis for thrust structures of the 75 K NERVA Full Flow Engine are documented. The design analyses include thermal, nuclear radiation, structural (loads, dynamics, stress), mechanical, and materials. In addition, Thrust Structure requirements, design descriptions, and reliability investigations are included. The design of the thrust train for the NERVA Engine is governed by structural and functional requirements as well as physical interactions from neighboring components. The thrust train must transmit force due to engine thrust to the flight vehicle, provide a means for command adjustment of thrust vector (that is, contain a hinge joint), provide a single plane interface with the flight vehicle for mechanical, fluid, and electrical connections, and fit the prescribed dimensional envelope dictated by specific design features of the engine. The thrust structure design to meet the requirements imposed upon the thrust train contains two elements; an upper thrust structure, and a lower thrust structure. Fundamentally, the upper thrust structure is an arrangement of girders within a circular box beam constructed entirely of aluminum sheet, extrusions, and forgings. The lower thrust structure interfaces functionally with the upper thrust structure thru the gimbal pivot to form the thrust train from the thrust chamber (pressure vessel and nozzle containing the nuclear reactor) to the flight vehicle. The lower thrust structure serves as a mount for the bulk of propellant feed system components, as well as a mount for a nuclear radiation shield for manned flight applications. The conclusions from the standpoint of a preliminary design examination are that: the UTS is a fundamentally sound design which needs detail refinements in analysis when its interfaces are better defined; the LTS requires extensive work in the area of basic design optimization prior to detail analytical refinement for a preliminary design review. The critical overheating problem with the external shield in place leads to the conclusion that aluminum could be unacceptable as the material of construction for the lower thrust structure. (auth)

32129 (TID/SNA-1107) FLEXIBILITY ANALYSES OF THE 1137400E ENGINE GIMBALED AT THE PRESSURE VESSEL (STA. 106.92). Oates, J. H. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 16 Nov 1971. 10p. Dep. NTIS $4.00.

The gimbaling capabilities of the 1137400E engine were evaluated for a gimbal point at the pressure vessel closure. Gimbaling within 1° about either the y or z axis was possible with some changes in the basic design. Loads and stresses were generally acceptable, i.e., less than 10,000 psi, with one exception (which was not completely resolved). Gimbal actuator requirements would be increased significantly. (LTN)

32130 (TID/SNA-1108) TRANSMITTAL OF "PROPELLANT FEED SYSTEM OVERHEATING ANALYSES" PORTION OF THE S-031 DATA ITEM, 75K NERVA THERMAL AND FLUID FLOW ANALYSIS REPORT, FOR ENGINE SYSTEMS DESIGN. Demuth, O. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 29 Oct 1971. 87p. Dep. NTIS $7.50.

The objectives of these thermal studies were: To evaluate the effect of the solar heat load in Earth orbit (1 AU) as compared to a Venus orbit (0.72 AU); to evaluate the use of coatings (flame-sprayed Al_2O_3) as compared to untreated component surfaces; to study the effect of insulating the TPA; to evaluate the effect of residual propellant in the TPA on housing-rotor temperatures as compared to a hard vacuum in the PFS; to evaluate the effect of engine orientation relative to the sun on component heating; a SINDA-70 mathematical representation of the Propellant Feed System (PFS) was developed. Both steady-state (space soak) and transient (heat-up after engine operation) runs were made to provide insight into the thermal characteristics of the PFS under selected conditions incorporating the above parameters. Solar heating is significant and, in Venus orbit, could be sufficient to result in temperatures unsafe for aluminum unless it is protected by coatings or other means. (auth)

32131 (TID/SNA-1110) ENGINEERING OPERATIONS REPORT: INSTRUMENTATION AND CONTROLS SYSTEM WEIGHT AND VOLUME STUDY. Project 150, Work Statement Paragraph f5c. Gilles, W. P. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 12 Jul 1971. 32p. Dep. NTIS $4.75.

A study was conducted to determine the optimum location for the I&C components in terms of total system weight and volume. The variables were: Cable weight, including that between the bottom of the stage tank and the top; I&C component volume which, as a function of location, very significantly affects shield volume and weight and, therefore, total package size; and radiation tolerance of devices used which directly impacts shielding requirements and, therefore, total package size and weight. This study concludes that, for the present, all I&C electronics except the computer should be considered as mounted on the engine, in the region immediately forward of the external shield. The basis for this decision is as follows: Potentially, this is the lowest possible weight system; weight can be further reduced by using radiation hardened items or by allowing maintenance after each mission; the program schedule permits time to pursue this radiation hardening problem without jeopardizing schedules; and concentration on this difficult task will produce more information upon which to base a final location decision at some later time. (auth)

32132 (TID/SNA-1111) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Engine, NERVA, 75K, Full Flow. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 135p. Dep. NTIS $9.75.

32133 (TID/SNA-1119) CONCEPT DESIGN STUDY OF GIMBAL BEARING ASSEMBLIES FOR NERVA (PRELIMINARY). Lutton, L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Jan 1970. 72p. Dep. NTIS $6.75.

Nine gimbal bearing concepts, which appear able to meet the performance requirements of the NERVA engine within the space allotted in recent configuration layouts were studied. Three frame diameters and three styles of bearing comprise the elements com-

bined into the nine concepts studied. Diameters considered fall into three categories, the first being those large enough to mount on the outer portions of the middle thrust structure and upper thrust structure, thereby avoiding large bending moments and deflections in the adjacent thrust structure transverse members to which the gimbal assembly attaches. In the second category there are two minimal-diameter "universal joint" concepts. Medium diameter concepts fall into the third category. The study considers bearings of three types; plain-bearing type, rolling element anti-friction bearing, and cross-flexure pivot. The medium diameter bearing using cross-flexure pivot is the optimum choice among the concepts considered. (auth)

32134 (TID/SNA-1120) SECTION 1. FLIGHT ENGINE ASSEMBLY LAYOUT, DRAWING NO. 1136339 N/C. (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 Jul 1969. 313p. Dep. NTIS $18.75.

The efforts of the Shielding Trade Study culminated in a presentation at SNPO-C on 23 May 1969 followed by a decision to incorporate a disc external shield forward of the PV dome in place of the brim shield on the reference engine design. With this change the internal NSS shielding was reduced from 21 inches to 15 inches. This change in engine shielding was a major one affecting the NSS, pressure vessel, thrust structures and PFS line configurations. Consequently a new engine layout, Drawing No. 1136339 N/C, was prepared to develop a reference engine concept for the systems engineering effort. The engine is described and backup information is included. (auth)

32135 (TID/SNA-1121) ENGINE LAYOUT AND FLOW SCHEMATIC DRAWINGS. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 57p. Dep. NTIS $6.00.

32136 (TID/SNA-1122) 1137400C ENGINE COMPONENT DRAWINGS. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 92p. Dep. NTIS $7.75.

32137 (TID/SNA-1123) NERVA 75K FLIGHT ENGINE. I. Engine Assembly Layout. II. Engine Flow Schematic and Piping Diagram. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1969. 244p. Dep. NTIS $15.25.

A notebook containing a good draft of a hot bleed NERVA flight engine design report (drawing No. 1135222 N/C), Flow Schematic and piping (drawing No. 1135223), diagrams and supporting information has been documented. The 1135222 N/C engine layout was released as a baseline concept of the NERVA 75K Flight Engine design. The concept provides a Reference Engine configuration for the computer model analyses (CAM, CRAM, ETM, EDM, NETAP) as well as for the systems engineering efforts (FFD's/RAS's, specifications) leading to engine DRB. The bases for this Reference Engine concept are the previous engine layout configuration, design review meeting decisions and system trade study inputs. The major features of the 1135222 concept include a dual TPA propellant feed system, external brim shielding as part of the pressure vessel assembly, a thrust nulling concept, a nozzle assembly with a single hot bleed port, a skirt, and a skirt extension with an expansion ratio of 100 : 1, upper and lower thrust structures and engine gimbaling for TVC trim located forward of the dual TPA's. (auth)

32138 (TID/SNA-1128) INTERFACE DESIGN PROPOSALS FOR ICD 11363930. [nd]. 27p. Dep. NTIS $4.50.

Certain interface design changes are discussed along with the alternatives examined and the method of selecting one of them. The merits of the changes examined are difficult to evaluate without drawings and other referenced information. (LTN)

32139 (TID/SNA-1136) ENGINEERING OPERATIONS REPORT: NERVA TURBOPUMP BEARING RETAINER FABRICATION NON-METALLIC RETAINER. Project 121. Accinelli, J. B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 4 Apr 1972. 28p. Dep. NTIS $4.50.

The need for a low-wear, lightweight, high strength bearing retainer material with a radiation degradation threshold of 10^9 rads (C) prompted development of non-metallic reinforced polymers of the following types: Polybenzimidazole, polyimide, and polyquinoxaline. Retainers were machined from tubular laminates (billets) of the above polymers, including reinforcement by either glass or graphite fabric or filament. Fabrication of billets involves hot preimpregnation of the reinforcement fabric or filament with polymer followed by wrapping this "prepreg" over a heated mandrel to form a tube with the required thickness and length. The PBI/Graphite fabric laminates appeared to be the most desirable provided a repeatable hoop strength of greater than 15,000 psi could be achieved. Additional process development effort will be required with the PBI/Graphite fabric reinforced material to obtain higher and repeatable hoop strength. Such strengths were attained but not consistently. Some of the problems may be due to variations in different lots of resin, which affect the fabrication process. (auth)

32140 (TID/SNA-1137) INPUT FOR CY70 TECHNICAL SUMMARY REPORT. Stewart, J. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 9 Oct 1970. 42p. Dep. NTIS $5.25.

Input for a technical summary report has been documented. Analyses of space missions, vehicles, and trajectories have continued to establish requirements for the NERVA engine and to evaluate progress in meeting the requirements. Comparisons of the cost effectiveness of nuclear and chemical rockets for space missions have been made. Developmental progress in using engine after-heat for electrical generation is reported. Cooldown propellant can be saved by discontinuing pulses at a decay power of 200 kw. This results in a considerable increase in payload (which is partially reduced by increased engine and vehicle weight associated with the radiator, power conversion system, storage batteries and additional shielding). The net increase in payload is estimated to be 4000 to 12,500 lbs (this is in addition to the 47,950 lbs of payload currently estimated). Engine and stage interface coordination with other contractors and SNPO is discussed at length, with references. Finally, various possible types of acceptance tests for the NERVA engine are discussed, including checkout, inert gas flow, cold flow test, low power test, full power test, etc. There are many problems in this area which need to be considered carefully (especially the radioactivity after a full power test). (LTN)

32141 (TID/SNA-1143) INPUT FOR FIRST QUARTERLY PROGRESS REPORT CY 1971. Stewart, J. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 11 Jan 1971. 25p. Dep. NTIS $4.25.

Input for a quarterly progress report has been documented. Certain space missions have been analyzed with respect to their engine requirements with a view to optimizing reactor operation in light of the mission requirements, e.g., one long burn or two short ones to reach escape velocity, opimum pulse cool down techniques, optimum propellant vapor pressure at start, use of ullage gas (for low power operations, final maneuvers, etc.). Progress in specifications preparation is described (including traceability and verification, and provision of backup information). Certain trade study results are reported. Coordination with other contractors and SNPO on engine and stage interfaces is discussed at length. (LTN)

32142 (TID/SNA-1144) SUMMARY PROGRESS REPORT INPUT. Stephens, W. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 16 Nov 1971. 32p. Dep. NTIS $4.75.

Draft input to a progress report has been documented. NERVA engine design and specification changes are described and also some studies on optimum methods of reactor startup and shutdown. Radiation heating and shielding calculations have been made for alternative design configurations. Finally, possible hazards due to meteoroids have been investigated. Damage to small, but vital, components (such as valves, actuators, etc.) is not anticipated. Some lines and wiring may require shielding. A study of a protective space station garage for nonoperating periods is recommended, as well as further studies of possible meteoroid damage in general. Studies of the effect of coatings, etc. on solar heating have continued. (LTN)

32143 (TID/SNA-1145) EFFECT OF MALFUNCTION THRUST ON LUNAR SHUTTLE AND MARS VEHICLE PERFORMANCE. Unger, R. I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 11 Feb 1970. 9p. Dep. NTIS $4.00.

The effect of a malfunction of one of the two NERVA turbopumps is evaluated. It is concluded that, if an 80 percent thrust can be accepted with only one turbopump operating, the turbopump and engine weights can be reduced and the only effect of the malfunction of one pump will be the increased propellant required at the lower thrust (which decreases payload and usually must be provided as a reserve at the beginning of the mission). Since the major effect of operating at reduced thrust in the planned missions is on getting out of earth orbit at the first burn, it is recommended that, if failure occurs before the first burn, return to a space station and repair be considered. The reserve fuel requirement is much less if failure occurs at later burns in lower gravity forces (e.g., in lunar or mass orbit). Some additional ground rules are assumed in its calculation. (LTN)

32144 (TID/SNA-1147) EVALUATION OF MISSION ALM PAYLOAD PENALTIES FOR TURBOPUMP CHILLDOWN REQUIREMENT. Conn, K. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 8 Mar 1971. 13p. Dep. NTIS $4.00.

The payload penalty due to the amount of hydrogen propellant required to cool the Turbopump Assembly and the pump inlet

line before a burn is calculated for a variety of conditions (including only partial warm-up between closely spaced burns and with insulation on the turbopump assembly to slow warm up). In the latter case the insulation weighs 105 lbs and the payload penalty due to this extra weight is 292 lbs. The payload penalty for this usage of hydrogen varies from a few hundred to a few thousand lbs depending on the mission and time between burns. (LTN)

32145 (TID/SNA-1148) PRESSURIZATION GAS REQUIREMENTS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 8p. Dep. NTIS $4.00.

An estimate is made of the weight of hydrogen propellant lost in venting (this depends on the mission, the time between burns, etc.), lost in reactor startup and shutdown, and remaining as a reserve for malfunction at the end of the mission. The total amounts are of the order of thousands of pounds and have a significant effect on payload. (LTN)

32146 (TID/SNA-1149) MALFUNCTION THRUST/TANK PRESSURE/NPSP EFFECTS. PFS Trade Study 101. Stewart, J. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 24 Feb 1970. 20p. Dep. NTIS $4.00.

A study to determine the malfunction thrust level, tank pressure, and NPSP for the NERVA engine is reported. (JWR)

32147 (TID/SNA-1160) PROPOSED STUDY OF THE INFLUENCE OF FISSION PRODUCTS ON THE OPERATION AND DESIGN OF NUCLEAR ROCKETS. Preliminary Draft. (Aerojet-General Corp., Azusa, Calif. (USA)). Apr 1963. 12p. Dep. NTIS $4.00.

The effect of fission products on reactivity requirements, temperature coefficient of reactivity, post-shutdown power generation, and radiation effects, and the influence of these effects on rocket reactor design and operating procedures are reviewed. (auth)

32148 (TID/SNA-1166) CHEMICAL-NUCLEAR PERFORMANCE COMPARISONS (STAGING-THRUST-DURATION-SPECIFIC IMPULSE). Johnson, H. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 May 1963. 22p. Dep. NTIS $4.25.

32149 (TID/SNA-1173) STRUCTURAL ANALYSIS OF CYLINDRICAL PRESSURE VESSEL (CRYOSTAT) NO. 090683. Brode, D. M. (Aerojet-General Corp., Azusa, Calif. (USA)). Mar 1964. 52p. Dep. NTIS $5.75.

This analysis was performed to ensure the conformity of the cylindrical pressure vessel (090683) to the ASME Unfired Pressure Vessel Code. The code requires a factor of 5 on all vessels subject to external pressure. The vessel in question is a double walled cylinder utilizing a vacuum between the walls for insulation. Therefore, the factor of 5 was applied directly to the ambient pressure. For continuity of the analysis, the inner vessel, although maintaining internal pressure, was also designed to the above factor. (auth)

32150 (TID/SNA-1193) DUCT EXPERIMENTAL PROGRAM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Jun 1964. 20p. Dep. NTIS $4.00.

Drawings of Nerva reactor deflector ducts are presented along with graphs of ejector and chamber pressures in Nerva ejector configurations. (JRD)

32151 (TID/SNA-1197) N-4 PROGRESS REPORT FOR PERIOD 21 JUNE–20 JULY 1965. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1965. 24p. Dep. NTIS $4.25.

The Phoebus-1A full-power run is described. The performance of the instrumentation is discussed and design work on instrumentation for Phoebus-2B is summarized. (JWR)

32152 (TID/SNA-1202) NRX/EST PERFORMANCE EVALUATION. DRAGON Memoranda. EP-IIB. (Nuclear Rocket Test Operations, Jackass Flats, Nev. (USA)). Feb 1966. 194p. Dep. NTIS $12.75.

An evaluation of the data obtained from the NRX/EST experimental plan IIB testing is presented. (JWR)

32153 (TID/SNA-1204) NRX/EST PERFORMANCE EVALUATION. DRAGON Memoranda. EP III. (Nuclear Rocket Test Operations, Jackass Flats, Nev. (USA)). Mar 1966. 260p. Dep. NTIS $16.00.

An evaluation of the performance of the NRX/EST system during experimental plan III is presented. (JWR)

32154 (TID/SNA-1210) TEST PLAN FOR VENDOR ALUMINUM PRESSURE VESSEL ACCEPTANCE PROOF TESTS. Thomas, R. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 2 Jul 1963. 15p. Dep. NTIS $4.00.

This document describes the general test specifications for the vendor acceptance proof tests of NERVA aluminum pressure vessels. These tests are to be performed at the vendor's facilities prior to shipment of the pressure vessel to Aerojet-Sacramento (LRP). A successful test is a partial requirement for quality control acceptance of the delivered hardware. The test will consist of hydrostatically pressurizing the pressure vessel assembly, consisting of the closure and cylinder, capped with a flat plate bolted to the aft flange. The tests will be performed at ambient temperature. The ambient temperature proof pressure for these tests has been established in accordance with the NERVA TCA Structural Design Criteria. (auth)

32155 (TID/SNA-1257) NERVA AND KIWI-B NOZZLE JACKET PROGRAM. Inouye, F. T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Jan 1962. 72p. Dep. NTIS $6.75.

A metallurgical investigation was conducted in order to provide a nozzle-reinforcing jacket attachment for NERVA and KIWI-B. A process was successfully developed involving the static-consolidation from the melt of A-356 aluminum alloy onto prepared Type 347 tube bundle assemblies. The process provides a lightweight, integral reinforcing jacket capable of operating under the required hoop, longitudinal stress, and mechanical shock conditions without the need for additional weld, braze, or mechanical joints. The process has been found to be adaptable to full-scale jacket attachment to Titan XLR87/91-AJ-5 combustion chambers, several of which were successfully test-fired under operating conditions using Aerozine-50/N_2O_4. (auth)

32156 (TID/SNA-1266) CURRENT STATUS OF SCALE-MODEL DUCT PROGRAM FOR NERVA EXHAUST DISPOSAL SYSTEM. Revision 1. McFarland, B. L.; Nelson, R. E.; Patmor, G. O. (Aerojet-General Corp., Sacramento, Calif. (USA)). 21 Jun 1962. 35p. Dep. NTIS $4.75.

A scale-model program undertaken to develop a NERVA exhaust disposal system (NEDS) is described. Results of investigations in the program are the basis for concluding that it is probable that the NEDS for engine test stand 1 will employ a short secondary ejector system and that the goals established for E-model engine operation cannot be obtained. Determination of the specific operating conditions for this system is in progress and the system which is closest to attaining these goals while still providing acceptable flow and heat transfer characteristics will be selected for systems tests. The goal most likely to be compromised is the minimum chamber pressure for full nozzle flow which is important for both transient and steady state operation of the engine. (auth)

32157 (TID/SNA-1273) HEAT TRANSFER TESTS OF TPCV ACTUATOR. High, C. N. (Bendix Corp., South Bend, Ind. (USA). Bendix Products Aerospace Div.). 26 Jul 1963. 83p. Dep. NTIS $7.25.

The Turbine Power Control Valve Actuator Operates a butterfly valve which regulates the flow of hot hydrogen gas to a rocket engine turbine. The purpose of this investigation was to predict the resultant actuator components' temperature profiles when the actuator is exposed to the high temperature environment, and to use this information to predict whether auxiliary cooling is required under actual operating conditions. The testing program was divided into four phases so the relative effects of various input combinations on the components' temperature responses could be known. The actuator components which are predicted to present an elevated temperature problem are the microswitch, potentiometers, output shaft bearings, and diaphragm coating. (auth)

32158 (TID/SNA-1275) OPERATING LIMITS, NRX-A2 REACTOR. Revision I. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 17 Jul 1964. 30p. Dep. NTIS $4.50.

The constraints within which NRX-A2 reactor operations will be accomplished at the Nuclear Rocket Development Station (NRDS) are defined. These limits include both Management Controls and Operational Controls. Management Controls define the administrative limits associated with the NRX-A2 Operations Program. These limits include the definition of the test organization, the required documentation and the documentation approval mechanism. Operational Controls define the boundaries, procedural safeguards and operating safety limits, within which NRX-A2 operations will be completed. The scope of operations covered by this document includes those operations from receiving and inspection through post-test disassembly. (auth)

32159 (TID/SNA-1283) WORK ACCOMPLISHMENTS, CY 1963 FINAL REPORT BY SUBTASK. (Aerojet-General Corp., Sacramento, Calif. (USA)). 23 Oct 1963. 115p. Dep. NTIS $8.75.

Progress in the design, fabrication, and testing of NERVA engine components and systems is reported. (JWR)

32160 (TID/SNA-1300) NERVA RADIATION ANALYSIS COMPUTER CODES COLLECTION. Volume I. Summary.

Warman, E. A.; Rogers, D. R.; Lindsey, B. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1972. 95p. Dep. NTIS $7.75.

The NERVA Radiation Analysis Computer Codes Collection includes programs written in FORTRAN-IV for the IBM-360/65 and UNIVAC-1108 systems. The collection is characterized by a common geometry routine for a series of Point Kernel and Monte Carlo codes, which permits the user to prepare the geometrical model once and have the opportunity of running either simple or sophisticated analyses for the entire problem confronting him or any part thereof. This collection also features the capability to perform coupled Discrete Ordinates/Monte Carlo analyses, thus allowing the user flexibility of employing each of these methods for those portions of any given problem where one technique has advantages over the other. Due to the modular programming involved in the coupling, the common geometry routine, and the flexibility afforded by the COHORT Monte Carlo package, a typical reactor problem can be started as a Discrete Ordinates analysis, carried through complicated three dimensional configurations with the exactness afforded by the Monte Carlo technique and involve any combination of these two or Point Kernel analyses at any point in the progression of the solution. Further, the extensive use of tape storage of output from each part of the package (e.g., the H01 particle history tape) allows reanalysis of different types (e.g., volume detectors, point detectors, etc.) to occur at any time after an initial problem has been completed. The collection includes a number of codes available elsewhere, which have been adapted to the 360/65 and 1108 systems. Although prepared in support of the NERVA program, this code collection is sufficiently general for nuclear industry wide application. (auth)

32161 (TID/SNA-1330) SNP-1SA3-CONTRACT MONTHLY LETTER REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1964. 90p. Dep. NTIS $7.50.

Research progress in the NERVA Engine development program is reported. (JWR)

32162 (TID/SNA-1350) TURBINE POWER CONTROL VALVE ACTUATOR, MODEL NT-C2, PART NO. 2775022, SERIAL NO. 13. Test Data and Results. Doussard, J. R. (Bendix Corp., South Bend, Ind. (USA). Bendix Products Aerospace Div.). Nov 1963. 29p. Dep. NTIS $4.50.

For Aerojet General Corp., Azusa, Calif.

The results of the tests performed to evaluate the Turbine Power Control Valve Actuator, Model NT-C2, Part Number 2775022, Serial Number 13 are presented. All tests were conducted at the facilities of the Bendix Products Aerospace Division, South Bend, Indiana, during September and October 1963. The test program included component evaluation tests, actuator performance tests at room temperature, performance tests at low temperature, and final calibration before shipment. Reproductions of actual actuator performance test data are included in this report. (auth)

32163 (TID/SNA-1351) RADIATION EFFECTS TESTS OF THE BENDIX MODEL NT-B4 TPCV ACTUATOR AND SYSTEM AMPLIFIERS IN THE GROUND TEST REACTOR. (Bendix Corp., South Bend, Ind. (USA). Bendix Products Aerospace Div.). Nov 1963. 49p. Dep. NTIS $5.50.

For Aerojet General Corp., Azusa, Calif.

The Bendix Model NT-B4, S/N 10, Turbine Power Control Valve Actuator was mounted to the test pallet by means of an adapter. This mounting provided mechanical support for no-load operation while under irradiation. An electrical harness, 120 feet long, provided the proper electrical connections between the actuator connector assembly and the actuator test console. Four copper-constantan thermocouples were also included in the actuator installation to record torque motor, gear motor, transmission, and feedback potentiometer temperatures. A $\frac{1}{4}$ inch diameter, 120 feet long, copper tube provided actuator drive gas while the exhaust was vented to atmosphere at the actuator. No auxiliary actuator coolant was provided. The above electrical/pneumatic hookup and test console were used for the laboratory checkout, as well as the tests with the actuator installed at the reactor. During the irradiation test, the vertical centerline of the actuator output shaft was parallel to, and approximately 10.5 inches from the west face of the reactor closet. Helium gas was routed via $\frac{1}{2}$ inch diameter tubing from a 65,000 scf tube trailer to a control room regulator which set the pressure at the actuator input to 150 psig. (auth)

32164 (TID/SNA-1359) TEST PLAN FOR VENDOR ALUMINUM PRESSURE VESSEL ACCEPTANCE PROOF TESTS. Revision A. Cornell, A. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 Apr 1964. 14p. Dep. NTIS $4.00.

The general test specifications for the vendor acceptance proof tests of NERVA aluminum pressure vessels are described. These tests are to be performed at the vendor's facilities prior to shipment of the pressure vessel to Aerojet-Sacramento (LRP). A successful test is a partial requirement for quality control acceptance of the delivered hardware. The test will consist of hydrostatically pressurizing the pressure vessel assembly, consisting of the closure and cylinder, capped with a flat plate bolted to the aft flange. The tests will be performed at ambient temperature. The ambient temperature proof pressure for these tests has been established in accordance with the NERVA TCA Structural Design Criteria. (auth)

32165 (TID/SNA-1362) BENDIX NERVA PROGRAM: SUMMARY REPORT, CONTRACT YEAR 1964. Williamson, J. R. (Bendix Corp., South Bend, Ind. (USA). Bendix Products Aerospace Div.). 31 Mar 1964. 109p. Dep. NTIS $8.50.

For Aerojet-General Corp., Azusa, Calif.

A detailed discussion of the design effort which took place during the period from November 1963 through February 1964 is presented. This effort concluded with the detailed design of a Turbine Power Control Valve (TPCV) actuator for use on the NERVA engine. This design, designated as Model NT-D1, is an extension of the NERVA actuator activity at Bendix. Major emphasis during this period was placed on reduction in size and complexity resulting in extensive modification of the transmission, the main housings, the gas supply channels, and the gear motor bodies. Component locations were rearranged based on the results of the temperature studies made earlier in the NERVA program. Since this program was terminated during the design phase, a number of recommendations are included which briefly outline the necessary development work remaining to be done before this project can be considered completed. (auth)

32166 (TID/SNA-1553) NTO SEMI-MONTHLY PROGRESS REPORT FOR THE PERIOD OF MARCH 16–31, 1968. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Mar 1968. 25p. Dep. NTIS $4.25.

Progress in NERVA test operations is reported. (JWR)

32167 (TID/SNA-1554) NRX TURBOPUMP ASSEMBLY, P/N 708800-99 J, S/N 0000017. Narrative End Item Report. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 51p. Dep. NTIS $5.75.

The acceptance and post test check procedures are described for the NERVA turbopump assembly consisting of a two-stage turbopump, propellant-cooled transmission, and a single-stage radial exit flow pump. (JWR)

32168 (TID/SNA-1556) NRX/EST TURBOPUMP ASSEMBLY, P/N 708800-69C, S/N 0000015. Narrative End Item Report. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 27p. Dep. NTIS $4.50.

The results of an acceptance test on the NERVA turbopump assembly are reported. (JWR)

32169 (TID/SNM-6) PEWEE 2 SHUTDOWN STUDIES: EXPERIMENTAL PLANS III AND IV, APRIL 30, 1970 AND MAY 21, 1970. Logan, E. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1970. 69p. Dep. NTIS $6.50.

Studies with the Pewee II Reactor are reported. Several involved reactor shutdown procedures aimed at reducing pressure oscillations in the lines and determining LH_2 management procedures and flow characteristics following emergency shutdown. Detailed experimental results are given. (LTN)

32170 (TID/SNM-14) AGC DUAL MODE PUMP TESTS. Experimental Plan IV. Final Test Report. (Los Alamos Scientific Lab., N. Mex. (USA)). 16 Apr 1970. 82p. Dep. NTIS $7.25.

The objectives of Experimental Plan IV of the AGC Pump Test Series were: To evaluate the capability of one turbopump to continue to supply a constant discharge pressure and flow rate with simulated failure of the other turbopump; to evaluate the capability of the turbopumps to supply a constant discharge pressure and flow rate under simulated failure conditions in the turbine drive system; to determine the stability limit of the dual turbopumps at low Q/N values; to determine the stall point of a single turbopump; and to perform a startup with one pump chilled. The tests were successful and the results are given in detail. (auth)

32171 (TID/SNM-15) AGC DUAL MODE PUMP TESTS. Experimental Plan II. (Los Alamos Scientific Lab., N. Mex. (USA)). 5 Mar 1970. 56p. Dep. NTIS $6.00.

The objectives of Experimental Plan II were: To perform a startup of the pumping system in a partially chilled condition; to investigate the stability of the pumping system during small step changes in the discharge impedance; and to investigate the stability of the pumping system during simulated failures in the turbine drive system. The tests were successful and the detailed results are given. (auth)

32172 (TID/SNM-16) AGC DUAL MODE PUMP TESTS. Experimental Plan I. (Los Alamos Scientific Lab., N. Mex. (USA)). 1 Feb 1970. 89p. Dep. NTIS $7.50.

The objectives of Experimental Plan I (EP-I) of the AGC Pump Test Series were: To verify proper operation of the pumps, both individually and in the dual mode configuration; to determine the stem position versus area relationship of the pump bypass valves; to evaluate the control system stability and verify proper operation of the system control modes; to perform a mapping of the dual pump system head-flow characteristics; and to determine the stability of the single and dual mode configurations operating at design conditions and examine possible interactions between the two pumps. The pumps performed satisfactorily and detailed results are given on graphs. (auth)

32173 (TID/SNM-18) FULL-FLOW-ENGINE SUMMARY. Germantown, Maryland. (NERVA Test Operations, Jackass Flats, Nev. (USA); Aerojet-General Corp., Sacramento, Calif. (USA)). 12 Feb 1969. 111p. Dep. NTIS $8.75.

32174 (TID/SNM-20) FLUIDIC PROGRAMMER I. R. AND D., 2ND QUARTER PROGRESS REPORT (MARCH 1, 1970–MAY 30, 1970). Felsing, G. W. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 25p. Dep. NTIS $4.25.

The second portion of a program to demonstrate a NERVA engine programmer concept has been completed. A selected portion of the programmer that produces the chamber temperature and pressure demand profiles has been designed. All programmer circuit components, with the exception of one remaining to be examined, have been successfully tested. A minimization analysis has been developed to aid in future designs. (auth)

32175 (TID/SNW-1) DEVELOPMENT OF NUCLEAR INSTRUMENTATION. NERVA Project. Progress Report, September 15, 1962–November 15, 1962. Blewitt, D. D.; Wissman, A. J.; Bush, N. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Nov 1962. 72p. Dep. NTIS $6.75.

For Westinghouse Astronuclear Labs.

Progress of the design and testing of radiation resistant circuitry of the NERVA nuclear instrumentation is presented. Construction, testing and laboratory evaluation of irradiation models of the two 2E power range preamplifier circuits, the tetrode pulse preamplifier and two compound follower cable driver circuits, was completed. Irradiation testing and analysis of results was completed on the 2E preamplifiers, the tetrode pulse preamplifier and cable driver and the coaxial cable samples. A laboratory breadboard of a final flight-type pulse preamplifier has been designed and constructed but not yet tested. Design and construction has been started on certain portions of the payload follow circuitry. (auth)

32176 (TID/SNW-11) RADIATION EFFECTS PROGRAM AT WANL SUPPORTING THE NERVA PROGRAM. Coombe, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1968. 28p. Dep. NTIS $4.50.

A history of the program is given: various components, instruments, and materials were tested. Some of the experimental setups and facilities are shown and discussed. (DLC)

32177 (TID/SNW-16) FIRST DRAFT: PRELIMINARY WANL INPUT TO CONTROL DRUM DRIVE ASSEMBLY, PART OF NERVA NUCLEAR SUBSYSTEM FAILURE MODE, EFFECTS AND CRITICALITY ANALYSIS. Spezialetti, I. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Jul 1970. 38p. Dep. NTIS $5.00.

The Control Drum Drive Assembly (CDDA) consists of eighteen (18) individual Control Drum Drive Units (CDDU), each consisting of: An actuator mechanism, an Actuator Malfunction Over-ride Device (AMOD), and a controller. The actuator mechanism is an electric actuator, which in response to signals from the controller, provides a torque output used to impart rotary motion to a reactor control drum. The AMOD, under normal operating conditions, is the drive shaft which transmits the torque output of the actuator mechanism to the control drum. For emergency operation, the AMOD, upon a signal from the control systems, disengages the actuator mechanism and rotates the control drum to the "orifice angle" position from any position within the working range of the drum. The controller provides conditioned signals to the actuator in response to input demand signals from the controls system. The CDDA is a proportional control system, which in response to signals from the controls system, positions the reactor contol drums to provide reactivity control of the nuclear subsystem. Possible failure modes of this equipment are analyzed, their effects predicted and any required emergency action specified. (auth)

32178 (WANL-TME-1921) PROPORTIONAL ELECTRIC ACTUATOR DEVELOPMENT TEST REPORT. Kowalcheck, H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1969. 57p. Dep. NTIS $6.00.

The testing of a proportional electric actuator candidate, Responsyn stepping motor, Model HDUM-30-100-04, is described. The purpose of the tests was to obtain performance data on the proportional electric actuator candidate to verify analytical design parameters, and to optimize the parameters for the best overall subsystem performance. The results are required for control drum actuator and structural support coolant valve actuator system design and analysis and they are to be used as a partial input to actuator trade studies. Trade studies will be performed to select preferred and recommended actuators for the NERVA reactor. (auth)

32179 (WANL-TME-2691) STRUCTURAL SUPPORT COOLANT VALVE ACTUATOR. Trade Study No. 755. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1970. 216p. Dep. NTIS $14.00.

Eleven actuator concepts for application as a Structural Support Coolant Valve Actuator (SSCVA) and one single system concept as a complete structural Support Supply System are evaluated. The 11 actuators are either pneumatic or electric and the single system concept is fluidic. Conceptual drawings are included for each concept. Failure mode analysis, fault tree analysis and safety analysis are performed on each concept. In addition, qualitative evaluations are made by WANL structural, thermal and radiation disciplines. A comparison matrix is included to summarize all pertinent information about each concept. Selected parameters such as weight, reliability, safety, experience and performance are used to select one concept of each type as the recommended approach. Westinghouse recommends a Permanent Magnet Rotor Electric Stepper Motor as the electrically-operated selection and a Single Piston Rack and Pinion as the pneumatically operated selection. Because of the anticipated future potential of an all-fluidic SSCVA system, Westinghouse further recommends that continuing assessment and development be carried out to determine its applicability and merits. (auth)

32180 (WANL-TME-2699) OPTIMIZATION OF P_c FOR NSS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1970. 20p. Dep. NTIS $4.00.

A trade study evaluated the effects on the NSS and its components of varying rated chamber pressure from 300 to 600 psia for the ten-hour full flow engine for both nominal twin TPA and malfunction single TPA operation. After considering fuel element corrosion, hot end support creep, reliability, weight and developmental risk, two NSS recommendations were made. For a dual pump engine design where operation at rated conditions with one pump failed is not required, a 550 psia chamber pressure is recommended. If operation is required at rated conditions with one pump failed, then 450 psia represents the best compromise for all NSS parameters involved. (auth)

32181 A METHOD AND DEVICE FOR REGULATING THE TEMPERATURE OF A HEAT EXCHANGER PRIMARY FLUID. Dupuy, G. (to CEA, 75 - Paris (France)). French Patent 2,184,398/A/. 15 May 1972. 9p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A heat-exchanger regulating device is described, resorting to the expansion of the coolant primary fluid. This device is characterized in that the exchanger enclosure upper portion comprises a U-shaped conduit the legs of which are directed downwardly, that of said legs which is not connected to the exchanger opening into the upper end of an auxiliary tank, the other end of which is connected to means for maintaining said exchanger and auxiliary tank at a substantially constant pressure. This device can be applied to the exchanger of a submarine thermionic reactor. (FR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 29174, 29598, 29599, 29603, 29605, 29642, 29644, 29646–29653, 29863, 29901, 29959, 30186, 31884, 32348, and 32349.

32182 (ANL-75-9) NONEQUILIBRIUM, TWO-PHASE CRITICAL DISCHARGE OF NEARLY SATURATED AND SUBCOOLED CCl_3F THROUGH SHORT TUBES. Prisco, M. R. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-eng-38. 108p. Dep. NTIS $5.45.

Thesis. Submitted to Marquette Univ., Milwaukee, Wis.

Two-phase critical flow data, both critical flow rates and critical pressure ratios, were obtained for sharp-edged entrance tubes for which $2.82 \leq L/D \leq 12.78$. The testing fluid was CCl_3F. The

ranges of stagnation pressures and temperatures were: 9.72 psia ≤ P_0 ≤ 16.74 psia and 35°F ≤ T_0 ≤ 72°F. Test sections of two major types were fabricated. The first type, termed the gradually diverging type, was a constant-area tube with a 7° included-angle diverging section affixed to the tube exit. The second type, termed the rapidly diverging type, was like the first, only the affixed diverging section had an included angle of 120° or 180°. The rapidly diverging test sections were made to be representative of test sections used to obtain critical flow data prior to 1968. By comparing runs of identical P_0, T_0, and L/D between the two types of test sections, it was determined that the expansion of the fluid at the exit plane of the rapidly diverging test section has caused investigators to misinterpret the actual critical-flow phenomenon. From such comparisons, it was concluded that a steep pressure gradient does not exist near the exit plane of a short tube nor is the exit-plane pressure in any way dependent on the receiver pressure while critical flow persists, contrary to the findings of previous investigators who used rapidly diverging test sections. (42 references) (auth)

32183 (ANL-75-17) OPERA SINGLE-PIN PUMP-COAST-DOWN EXPULSION AND RE-ENTRY TEST. Henry, R. E.; Singer, R. M.; Quinn, D. J.; Spleha, E. A.; Erickson, E. G.; Jeans, W. C. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-eng-38. 44p. Dep. NTIS $4.00.

Transient boiling results are reported for sodium boiling in a narrow annular channel with a high heat-flux input. Boiling is initiated by exponentially decreasing the liquid coolant flow rate in a manner similar to that expected for an LMFBR system in the event of a loss of power to the primary pumps. The test-section power (single pin) was maintained at a constant value during this flow transient. Analysis of the data shows that boiling inception occurred at the end of the heated zone at a small bulk superheat. The early voiding pattern is heavily influenced by the local condensation potential in the vicinity of boiling inception, and initial flow pattern, while reflecting some multibubble behavior, appears to be annular in nature. The vapor zone grows preferentially downstream until that region becomes saturated, at which time inlet flow reversal occurs. Following inlet flow reversal, no multibubble character is observed within the voided zone. Coolant reentry through the gas plenum region was only observed early in the voiding transient. (4 references) (auth)

32184 (BMI-1931) SIMPLIFIED STEADY-STATE ANALYTICAL MODEL FOR PREDICTION OF THE PRESSURE DIFFERENTIAL AND OUTLET FLUID PROPERTIES OF THE ECC INJECTION SECTION OF A TYPICAL PWR DURING A LOCA. Robinson, R. A.; Cudnik, R. A. (Battelle Columbus Labs., Ohio (USA)). 20 Jan 1975. Contract W-7405-eng-92. 80p. Dep. NTIS $5.45.

A steady-state one-dimensional analytical model has been developed to predict the ECC injection section pressure differential and outlet fluid conditions in a typical PWR system during a postulated loss-of-coolant accident. The model accounts for system size, angle of ECC injection nozzle to cold leg pipe, and inlet cold leg fluid conditions. Semiempirical correlations were employed in the model to account for single- and two-phase viscous losses and momentum losses associated with ECC injection and cold leg pipe turns. Verification of the model was made by comparing model predictions with experimental data obtained in the Combustion Engineering ⅙- and ⅓-scale steam relief test program. The model contains no empirical correction factors based on these data. The model has been compared with data obtained from tests in which oscillatory behavior was observed in the ECC injection section, and the comparison indicates that the model can predict the time-averaged injection section pressure differential and outlet fluid conditions for such tests. Both the model predictions and the experimental data show that the injection section pressure differential is in the range of +1.5 to −3.0 psid. For ECC injection angles less than 90 degrees, a jet pump action was both observed and predicted for the ECC injection section. A modified model was also developed to account for the effects of noncondensable gases that could be present in either the cold leg fluid venting from the reactor core or the ECC water that is injected into the cold leg piping. This model has not been compared with experimental data for verification. (14 references) (auth)

32185 (CENPD-134(Suppl.1)) COMPERC-II: A PROGRAM FOR EMERGENCY REFILL-REFLOOD OF THE CORE (MODIFICATIONS). (Combustion Engineering, Inc., Windsor, Conn. (USA)). Feb 1975. 20p. Combustion Engineering, Inc., Windsor, CT.

COMPERC-II computer code was written at CE to analyze the core refill and reflood transient portion of a PWR loss of coolant accident (LOCA). The COMPERC-II code has mathematical models to calculate the containment back pressure, the effect of the steam-water interaction in the injection section of the cold legs, the overall piping resistance to steam flow, the safety injection flow rate from the tanks, the material and fluid properties, and the FLECHT heat transfer coefficients for the reflood transient. Development work has continued on the COMPERC-II code. The changes that have been made to the COMPERC-II code are described. A new computer code "COMZIRC" which is used to calculate the core wide zircaloy-steam reaction is presented. (auth)

32186 (CENPD-135(Suppl.2)) STRIKIN-II: A CYLINDRICAL GEOMETRY FUEL ROD HEAT TRANSFER PROGRAM (MODIFICATIONS). (Combustion Engineering, Inc., Windsor, Conn. (USA)). Feb 1975. 18p. Combustion Engineering, Inc., Windsor, CT.

The STRIKIN-II code is a Fortran IV digital computer program which is used to calculate the core hot spot transient clad temperature during the blowdown, refill, and reflood portions of a loss-of-coolant accident. This supplement to the topical report documents changes made to the code in the areas of pre-rupture cladding plastic strain, the refill and reflood rod-to-rod radiation heat transfer calculation, and an improved treatment in the solution of the heat conduction equation at the gap interfaces. Changes pertaining to the analysis of unpressurized fuels are also presented. Two changes were made to STRIKIN-II to conform with the Regulatory Staff's position on the following items: inclusion of the NRC plastic strain model, and addition of a conservatism to the temperature calculation of the hot rod environment in the rod-to-rod radiation model. (auth)

32187 (CENPD-140(Amend. 2)) DESCRIPTION OF THE CONTRANS DIGITAL COMPUTER CODE FOR CONTAINMENT PRESSURE AND TEMPERATURE TRANSIENT ANALYSIS. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Mar 1975. 43p. Combustion Engineering, Inc., Windsor, CT.

Four design calculations are performed with CONTRANS: containment design pressure, containment design temperature, containment liner temperature analysis, and annulus building thermodynamic analysis. The heat transfer coefficients and break flow partition functions for each application are discussed. (auth)

32188 (COO-651-92) FINAL ELK RIVER REACTOR SITE SURVEY: RESULTS AND SUMMARY. (United Power Association, Elk River, Minn. (USA)). 23 Jul 1974. Contract AT(11-1)-651. 70p. Dep. NTIS $5.45.

The techniques and methods used during the final Elk River Reactor site survey are described, and the results of the survey are discussed. No evidence of radiation levels in excess of normal background was found during the final Elk River Reactor site survey. The radiation levels detected on site are consistent with normal levels previously measured in the off-site environment by the United Power Association during the routine environmental surveillance program. (auth)

32189 (EURFNR-1192) TRANSPORT OF CORE MATERIALS DURING ACCIDENTS IN LMFBRS (SLUMPING). Angerer, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Jun 1974. Translation of KFK-1935. 52p. Dep. NTIS $5.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

During a pump-coast-down accident in a LMFBR with simultaneous failure of the whole reactor protection system, fuel pins may melt. The relocation of the materials as a result of gravity, gas and vapor forces leads to feedbacks on the reactivity and therefore the reactor power, which influence the course of the accident considerably. The computer program SLB is a first attempt to describe the material transport during the accident theoretically. For this the reactor-core is subdivided into coolant channels radially, and into nodes axially. The material transport between the nodes of one and the same coolant channel is computed and the altered material distribution is given to a neutron kinetics program afterwards. As an example the course of pump-coast-down accidents with various values of a material movement parameter is computed. (28 references) (auth)

32190 (GEAP-13923-9) SAFETY ENGINEERING NINTH QUARTERLY REPORT, AUGUST–OCTOBER 1974. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1974. Contract AT(04-3)-893. 20p. AT.

The objective of the work reported under this program is to provide an independent evaluation of existing experimental data and analytical models relating to design and safety analysis of LMFBR cores, and to identify requirements for model development and testing in support of long-term LMFBR safety evaluations. Progress during August, September, and October 1974 is described. Fuel and cladding motion studies are reviewed.

BEHAVE-3 computer code development is described. 14 References. (auth)

32191 (NJD-10(Rev. 1)(Suppl. 1)) XE-1 SAFETY EVALUATION REPORT, PHASE IB. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 8 Apr 1968. 38p. Dep. NTIS $5.00.

The safeguards which will prevent accidental criticality in XE-1 during assembly, transport, and checkout operations from initiation of central poison wire removal up to, but not including, initial criticality at the Engine Test Stand (ETS-1) are summarized. A block diagram indicating the sequence of these operations is presented. (auth)

32192 (TID/SNA-354) NERVA SAFETY PLAN, S019-SS-09205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 136p. Dep. NTIS $10.00.

The NERVA safety program is described in detail. The program includes both flight and ground safety and covers safety review and auditing as well as the application of safety engineering in the design, development, testing, and operational phases. (JWR)

32193 (TID/SNM-12) NUCLEAR FURNACE SAFETY ANALYSIS REPORT. Part II. Test Operations. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Nov 1971. 282p. Dep. NTIS $17.25.

A safety analysis of the test operations phase of the Nuclear Furnace project is presented. Aspects covered include the test facility, the reactor thermal and neutronic properties, the planned test operations, and effluent source term predictions. (JWR)

32194 (WANL-TME-1038(Suppl.2)) NRX-A3 SAFETY EVALUATION REPORT. Supplement 2. Skaritka, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 May 1965. 10p. Dep. NTIS $4.00.

Several experiments, designed to obtain data on the operation of the NRX-A3 control system, have been proposed for the NRX-A3-EP-VI Test. The experiments will be conducted with nominal reactor condition of 150 MW power, 20 lbs/sec LH_2 coolant flow and 2100°R chamber temperature. They consist of transfer function measurements obtained by perturbing the control variables. Review of potential control system malfunctions related to this test shows that the reactor is adequately protected against such failures in that unsafe reactor conditions will not result or sufficient time is available for operator action to correct the condition. (auth)

32195 (WANL-TME-1061(Add.1)) SAFETY EVALUATION REPORT. Part 1. Review of Nuclear Safeguards for NRX Reactors During Pre-Test Assembly Operations at NRDS. Addendum 1. Central Poison Wire Removal Prior to Initial Criticality. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1966. 21p. Dep. NTIS $4.25.

It is concluded that poison wires may be removed from NRX reactor cores using neutron counting techniques which limit the wire withdrawal so that at the conclusion of withdrawal an indicated withdrawal of 325 wires would be required to achieve criticality. This will assure that the reactor will be shutdown by at least $2.75 with all drums at zero degrees. Safety after conclusion of wire withdrawal will be assured by periodic measurements of shutdown using a single drum rotation technique and by strict application of procedural controls to limit reactivity conditions so that a reactor shutdown is never less than $2.00. (auth)

32196 (WCAP-8431) PWR FLECHT-SET PHASE B1: DATA REPORT. Waring, J. P.; Rosal, E. R.; Hochreiter, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1974. Contract AT(11-1)-2279. 545p. Dep. NTIS $30.25.

Twenty tests from the Phase B1 portion of the FLECHT-SET program met the test specifications and the data obtained in the tests have been reduced and are presented. The tests examined system parameters such as test section inlet resistance, loop resistance, steam generator secondary water level, flow area in the upper plenum, and feedback of the intact loop flow to the downcomer. The effects provide a useful data base for the study of reflood system effects such as the development of reflood models and verification of reflood computer codes. The data reported include rod clad temperatures, heat transfer coefficients and quench times; fluid and wall temperatures throughout the system; inlet flooding rate; overall mass balances; steam generator secondary temperatures and pressures; and differential pressures on the test section, loop components, and piping. (auth)

32197 HYPOTHETICAL OVERPOWER EXCURSION MODEL FOR LIQUID METAL-COOLED FAST BREEDER REACTORS. Rumble, E. T. III. Los Angeles; Univ. of California (1974). 309p. University Microfilms Order No. 74-24,612.

Thesis (Ph. D.).

A mechanistic model for the LMFBR overpower excursion accident without safety shutdown is presented. The model assumes that the rigid subassembly ducts as well as the stainless steel clad fuel pins both maintain their geometry. The accident is considered from initiation at steady state conditions to either early termination with in-place cooling or to loss of the core's structural integrity. The fundamental unit described in the computer code HOPE (Hypothetical Overpower Excursion) developed for the study is a fuel pin with its associated coolant. All fuel pins in one subassembly are assumed to act coherently. Thus, a subassembly model includes a representative fuel pin, its coolant, and its associated subassembly jacket. Whole core excursions are modeled by describing the core as a collection of representative subassemblies or channels. Phenomena treated by the computer model include: reactor kinetics; steady state fuel behavior; steady state and transient fuel, clad and single phase coolant heat transfer; fuel melting and formation of a molten fuel-fission gas cavity; clad deformation and failure; fuel and fission gas ejection; fuel fragmentation and interaction with the coolant; fuel movement and reactivity feedbacks. The model is applicable to all burnup and operating power conditions of either LMFBR whole cores or single pins in which sodium coolant boiling does not occur prior to clad failure. Attention is devoted to new areas of study incorporated in the model. These include: clad failure time and location predictions based on permanent deformation; fission heating of fuel particles which exist in the coolant channel; and space and time dependent fragmentation of ejected fuel. A number of single pin studies are presented which analyze the nature of specific phenomena. In addition, a whole core sensitivity study of a 300-MW(e) LMFBR prototype is described. The results show that fuel pin failure height is the most important factor dominating the moderate input reactivity ramp rate accidents studied. (Diss. Abstr. Int., B)

32198 RIGOROUS CONTROL AND SUPERVISION FOR SECURE NUCLEAR POWER STATIONS. Bergstroem, G.; Printz, G. (Angpannenfoereningen, Stockholm). Tek. Tidskr.; 104: No. 15, 23-24; 16(4 Oct 1974). (In Swedish).

To secure a safe nuclear power station rigorous control of the components is essential, and the finished plant must be subjected to a first inspection. To maintain security under operation it is necessary to provide for the so-called revision inspection. Experience from the activities of the Association for the Supervision and Inspection of Boilers shows that these controls demand major and throughgoing work. The scope of the inspection is dependent on the various security categories, and stringent manufacturing control for sensitive components is essential. Some of the precautions employed are listed and illustrated. (SW)

32199 INFLUENCE OF THE NUCLEAR POWER PLANT KRSKO ON THE ENVIRONMENT. Karuza, J.; Strohal, P. (Elektroprivreda, Zagreb). Elektroprivreda; 26: No. 3-4, 111-121 (1973).

The effects on living beings and the natural environment to be expected after building of the nuclear power plant Krško is considered. Particular attention is given to the radiation sources in the plant itself and the radiation effects on the environment. Considered is also the question of warm cooling water discharge into the Sava River. (Bull. Sci., Sect. A)

32200 ON THE PROCESS OF REWETTING A HOT SURFACE BY A FALLING LIQUID FILM. Thompson, T. S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Eng. Des.; 31: No. 2, 234-245(1974).

A two-dimensional transient heat conduction model for rewetting a hot surface by a falling liquid film predicts that for stainless steel, Inconel, or Zircaloy only a wall thickness of some 0.020 in. takes part in the rewetting process in steam at 100–1000 psia. The rewetting rate is nearly independent of heat flux and thermal conductivity, but increases with pressure and decreases with volumetric heat capacity. (auth)

32201 THE USE OF FREQUENCY-INDEPENDENT SOIL-STRUCTURE INTERACTION PARAMETERS. Tsai, N. C.; Niehoff, D.; Swatta, M.; Hadjian, A. H. (Bechtel Power Corp., San Francisco, Calif. (USA)). Nucl. Eng. Des.; 31: No. 2, 168-183 (1974).

The validity of approximating frequency-independent foundation impedance functions by constant parameters was evaluated for nuclear power plant structures. The soil-structure interaction system with the frequency-dependent impedances was analyzed using the Foss method to uncouple the equations of motion; this method closely follows the method developed by Jennings and Bielak. The interaction system with the constant impedances was approximately analyzed by the normal mode method using equivalent modal damping values computed according to a procedure developed by Tsai. The two methods were applied to simplified containment structural models founded on an idealized elastic half-space, the shear wave velocities being taken to be 600, 1150, 2000 and 10,000 ft/sec. The results such as fre-

quencies, damping, and in-structure response spectra were then compared. It was concluded that frequency-independent foundation impedances can be adequately used for plant sites having relatively deep and uniform overburdens. (auth)

32202 THE DYNAMIC MODELING OF THE HALF-PLANE BY FINITE ELEMENTS. Luco, J. E. (California Inst. of Tech., Pasadena (USA). Div. of Engineering and Applied Science); Hadjian, A. H.; Bos, H. D. (Bechtel Corp., Los Angeles, Calif. (USA)). Nucl. Eng. Des.; 31: No. 2, 184-194(1974).

A comparison was made between the vertical, rocking and horizontal impedance functions for a rigid strip foundation placed on homogeneous soil obtained by the finite element approach and the corresponding functions obtained for an elastic half-plane. An attempt was made to determine the overall size of the finite element model and the material damping necessary to approximate the two-dimensional half plane results over the frequency range of interest. The results indicate that even for large overall sizes of the model, the impedances obtained by the finite element approach present important oscillations depending on the value of the frequency. Such oscillations may be reduced by further increasing the overall size of the model or by increasing the material damping; however, the last approach would lead to an overestimation of the radiation damping. The errors associated with the vertical, rocking and horizontal impedances are of different magnitudes, the largest corresponding to the vertical impedances. The size of the elements was chosen such that the impact on the results obtained was minimal. It is expected that the use of larger size elements would further complicate the modeling problem. (auth)

32203 TWO-DIMENSIONAL APPROXIMATIONS TO THE THREE-DIMENSIONAL SOIL-STRUCTURE INTERACTION PROBLEM. Luco, J. E. (California Inst. of Tech., Pasadena (USA). Div. of Engineering and Applied Science); Hadjian, A. H. (Bechtel Corp., Los Angeles, Calif. (USA)). Nucl. Eng. Des.; 31: No. 2, 195-203(1974).

The feasibility of representing a three-dimensional soil-structure interaction problem by a plane strain model, and the errors involved in such representation, were studied. By comparing the rocking and translational force-displacement relationships for a rigid circular foundation placed on an elastic half-space and the corresponding relationships for a strip footing placed on an elastic half-plane it was found that it is not possible to obtain a two-dimensional representation that will approximate both the dynamic stiffness and radiation damping over a reasonable range of frequencies. Several two-dimensional models were considered and a measure of the errors involved is presented. In general, the two-dimensional models overestimate the radiation damping associated with the three-dimensional problem. To study the effects that the use of a two-dimensional plane strain model may introduce in the solution of the soil-structure interaction problem for typical nuclear power plants, a comparison was made between the system frequencies and modal dampings obtained for three and two-dimensional models. The corresponding response at the top of the containment shell, top of the internal structure, and base slab for a particular earthquake were also compared. It was found that by properly selecting the two-dimensional model it was possible to obtain close approximations to the system frequencies. However, since the dampings associated with the low frequency modes are overestimated, the earthquake response of the structure, as obtained by the two-dimensional model, is underestimated to a significant degree. (auth)

32204 IMPEDANCE FUNCTIONS FOR A RIGID FOUNDATION ON A LAYERED MEDIUM. Luco, J. E. (California Inst. of Tech., Pasadena (USA). Div. of Engineering and Applied Science). Nucl. Eng. Des.; 31: No. 2, 204-217(1974).

The problem of harmonic forced vibrations of a massless rigid disc supported on an elastic layered medium is studied. The elastic medium consists of a layer of constant thickness placed on an elastic half-space. The contact between the layer and the underlying half-space is such that continuity of displacements and stresses at the interface is secured. Forced vertical, rocking and horizontal vibrations with harmonic time dependence are considered under the assumption of relaxed bonding between the rigid disc and the surface layer. The resulting mixed boundary value problems are reduced to sets of Fredholm integral equations that are solved numerically for a wide range of frequencies. The force-displacement relationships thus obtained present several differences with the corresponding results for a homogeneous half-space. In general, the rocking impedances are the least affected by layering, while the vertical impedances are the most affected. The impedances for a layered medium show a stronger frequency dependence than the impedances for the half-space. For intermediate and high contrast between the elastic properties of the layer and those of the half-space there is a considerable reduction of the radiation damping for low frequencies. (auth)

32205 SIMPLIFIED SOIL-STRUCTURE INTERACTION ANALYSIS WITH STRAIN DEPENDENT SOIL PROPERTIES. Hadjian, A. H.; Niehoff, D.; Guss, J. (Bechtel Corp., Los Angeles, Calif. (USA)). Nucl. Eng. Des.; 31: No. 2, 218-233(1974).

Recent work regarding the response of above-ground soil structures, such as dams, has indicated the need to use strain dependent soil properties. Unlike other building materials, soil has stiffness and damping properties which are highly strain dependent. The application of these concepts to problems in soil-structure interaction has also been suggested. It is suggested that answers similar to those given by the strain dependent solution of finite element models can be obtained more simply by the use of lumped-parameter impedance functions. To establish this equivalence, it is imperative that all other variables in the problem be made equal for both models; that is, the strain dependency problem must be isolated if the comparison of the two approaches is to be meaningful. A method is proposed which uses a damping value equal to the average strain dependent soil profile damping. The strain dependent soil profile damping values are obtained by the use of a much simpler model using one-dimensional wave propagation theory. From this same one-dimensional model, the strain dependent soil stiffness corresponding to the average top layer of soil with and without an overburden to approximate the superstructure is used in the equivalent simplified model. Several case comparisons indicate the validity of the proposed method. (auth)

32206 SOIL-STRUCTURE INTERACTION: CONTINUUM OR FINITE ELEMENT. Hadjian, A. H. (Bechtel Corp., Los Angeles, Calif. (USA)); Luco, J. E. (California Inst. of Tech., Pasadena (USA). Div. of Engineering and Applied Science); Tsai, N. C. (Bechtel Power Corp., San Francisco, Calif. (USA)). Nucl. Eng. Des.; 31: No. 2, 151-167(1974).

A survey of both the continuum and the finite element approaches to the soil-structure interaction problem is made. The limitations and advantages of both methods are evaluated with emphasis on the present state of the art. Some recommendations are made regarding the circumstances under which one or the other approach should more appropriately be used. (auth)

32207 CALCULATIONS ON THE REWETTING OF HOT SURFACES. Coney, M. W. E. (Central Electricity Research Labs., Leatherhead (UK)). Nucl. Eng. Des.; 31: No. 2, 246-259 (1974).

Previous theoretical and experimental work has shown that the rate of advance of a quench front over a hot surface is a function of the initial temperature, the thickness and the physical properties of the hot surface, and the cooling water flow conditions. The heat conduction problem, which determines the quench rate, is solved accurately by an analytic method which requires a computer. The results, based on a constant heat transfer coefficient in the wetted region, can be applied to most conditions of practical interest and are applied to determining the quenching heat transfer coefficient and the sputtering temperature from previous experimental results at high pressures, with cooling water near its saturation temperature. (auth)

32208 BEHAVIOR OF SNR FUEL ELEMENTS UNDER COOLANT-LOSS CONDITIONS. I. Kwast, H. Atoomenergie Haar Toepass.; 17: No. 1, 12-18(Jan 1975). (In Dutch).

The principal features of the SNR reactor are reviewed, including details of the enriched- UO_2 fuel-pin assembly. Results of experiments in which fuel elements were subjected to the kind of temperature and pressure surges predicted by computer simulation for extreme coolant-loss conditions are described. Several fuel-can failures were noted which, under operational conditions, could have resulted in radiation release. (NL)

32209 SIMULATION OF THE TRANSIENT BEHAVIOUR OF LMFBR FUEL PINS UNDER CONSIDERATION OF SPECIAL BURNUP PHENOMENA USING THE BREDA-II MODEL. Kuczera, B. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Nucl. Eng. Des.; 31: No. 2, 294-307(1974).

A new fuel pin model was developed to describe the influence of specific burnup phenomena on the behavior of LMFBR fuel pins under transient overpower conditions. It has been used for transient fuel pin deformation analysis during hypothetical core disruptive accidents (HCDA) and for the purpose of interpreting fuel pin failure tests. The fuel pin model, designated as BREDA-II, is based on the equations of the quasi-static theory of thermal elasticity. The fuel is regarded as elastic and the cladding as elasto-plastic material. The equations for the stress-strain analysis are based on the plane strain approximation. A multiregion fuel pin model incorporates long-time and transient burnup phe-

nomena. The long-time effects taken into account are the steady state swelling of fuel, the change in fuel porosity, and the production and partial release of fission gases. During a power excursion transient fuel swelling and pressure increase due to transient fission gas behavior are included in the deformation analysis. Potential fuel pin failure is indicated by the application of various failure criteria. In subsequent model calculations the behavior of an irradiated LMFBR fuel pin during an overpower transient corresponding to a reactivity ramp of $5/sec is simulated and interpreted from the point of view of reactor safety. (auth)

32210 EFFECT OF A STABILIZING TEMPERATURE GRADIENT ON HEAT TRANSFER FROM A MOLTEN FUEL LAYER WITH VOLUMETRIC HEATING. Suo-Anttila, A. J.; Catton, I. 74-WA/HT-45. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The Landau method is used to determine the heat transfer to the upper and lower surfaces of a volumetrically heated layer of molten fuel for various fixed values of the upper and lower surface temperatures. To use the Landau method, the Stuart Shape assumption is imposed and solutions to the linearized stability problem are utilized. The results are generalized in terms of two Nusselt numbers (upper and lower surface heat transfer) which are presented as a function of Rayleigh number based on the internal heat generation for various values of an external Rayleigh number based on the surface to surface temperature difference. Results are also presented for molten UO_2 layer for various typical values of decay heat. Comparison is made with experiment, where possible, and found to be good. 12 references. (auth)

32211 LOSS-OF-FLOW TESTS IN SINGLE- AND SEVEN-PIN GEOMETRIES. Kikuchi, Y.; Haga, K.; Ohtsubo, A. 74-WA/HT-44. New York; American Society of Mechanical Engineers (1974). 13p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Loss-of-flow tests have been conducted in a single-pin and a seven-pin geometries. The incipient-boiling (IB) wall superheat correlates with the rate of the temperature rise. The pressure rise at the initial vaporization compares well with the vapor pressure corresponding to the IB wall superheat. The pressure pulse occurred at the vapor collapse correlates reasonably well with the reentrant velocity of the liquid column and agrees quite well with the theoretical value predicted from the sodium-hammer analysis. The void pattern observed in the single-pin experiments agrees fairly well with that calculated by the NAIS-P2 code (single-bubble slug-ejection model), whereas in the seven-pin experiments, the two-dimensional voiding pattern is dominant. The thickness (0.05 and 0.45 mm) of the residual liquid film becomes thinner with higher IB wall superheat. 8 references. (auth)

32212 MASS HOLDUP, PRESSURE, AND TIME-TO-DRYOUT PREDICTIONS UNDER LOCA CONDITIONS. Comparisons with Scaled-Down Experimental Results. Gaspari, G.; Granzini, R.; Premoli, A.; Sandri, C. 74-WA/HT-43. New York; American Society of Mechanical Engineers (1974). 16p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Analytical models and codes to predict thermohydraulic transients in heavy and light water reactors are described. The experimental measurements relevant to the tests presented here were carried out on a scaled-down blowdown facility in terms of pressure, heated channel mass holdup, and time-to-dryout or CHF under transient conditions determined by flow stoppage or decay, break at different positions, and power excursions. The tests were performed with tubular and annular heated channels. Much care was taken to detect the wall thermal excursion by means of wall thermocouples, suitably mounted to obtain an overall time response of 200 ms order. A blowdown code, called TILT, was developed and systematically checked on the basis of a large experimental background. The different kinds of available measurements (pressure, mass holdup and time-to-dryout) allowed to analyze and check separately the different models included in the code, namely pressure drop, slip ratio and critical heat flux correlations. On the basis of this analysis, the TILT code has proved to be already at the present state of development of a useful tool for predicting the thermohydraulic transient typical of reactor blowdown for quite a large variety of conditions. 12 references. (auth)

32213 REVIEW OF FRAGMENTATION MODELS RELATIVE TO MOLTEN UO_2 BREAKUP WHEN QUENCHED IN SODIUM COOLANT. Cronenberg, A. W.; Grolmes, M. A. 74-WA/HT-42. New York; American Society of Mechanical Engineers (1974). 24p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

An important aspect of the fuel-coolant interaction problem relative to liquid metal fast breeder reactor (LMFBR) safety analysis is the fragmentation of molten oxide fuel on contact with liquid sodium coolant. In order to properly describe the kinetics of such an event, an understanding of the breakup process and an estimate of the size and dispersion of such finely divided fuel in coolant must be known. In recent years, considerable interest has centered on the problem of determining the nature of the fragmentation process. Both analytic and experimental studies pertaining to such breakup are reviewed in light of recent developments in the understanding of heat transfer and solidification phenomena during quenching of UO_2 in sodium. Where possible, an attempt has been made to assess the work potential for fragmentation of the various models proposed and compare the predicted particle size from such models with experimental results. 62 references. (auth)

32214 ANALYSIS OF A LOCKED PUMP ROTOR ACCIDENT IN A PWR. Chu, P. T.; Risher, D. H.; Steitler, R. W. 74-WA/HT-46. New York; American Society of Mechanical Engineers (1974). 11p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The analysis methods and results of an investigation of a locked-rotor type accident on a pressurized water reactor plant are presented. This incident is postulated to result from a pump shaft seizure or failure. A locked rotor can result in a severe transient with respect to fluid flow and heat transfer in a PWR. Reverse flow in the affected loop occurs within 1 sec, causing a rapid reduction in core flow and therefore a reduction in core heat removal. A DNB and clad temperature analysis are performed to ensure the integrity of the fuel. Three-dimensional transient velocity fields have been calculated for the flow in the downcomer and core region of the reactor vessel. It is concluded from these results that the rapid flow velocity changes would not contribute to worsening the consequences of the accident. Qualitatively, the steady-state results are verified by experimental observation. 8 references. (auth)

32215 APPLICATION OF DRIFT FLUX TO LOSS OF COOLANT ANALYSIS. Kelly, R. D.; Dougall, R. S.; Cantineau, B. J. 74-WA/HT-40. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Analysis of the loss-of-coolant (LOCA) for a nuclear power plant requires simulation of steam and liquid phases in various regions of the reactor. Historically this has been done by either the homogeneous model or the "bubble rise" model. These models are considered inadequate because they do not allow the two phases to have different, non-zero velocities. A new treatment which overcomes this deficiency has been developed and implemented in LOCA analysis. The new model is based on the "drift flux" concept and thus is able to simulate slip flow. Moreover the model treats counter-current flow and is compatible with the flooding relationship which limits counter-current flow. 14 references. (auth)

32216 NUCLEAR STATION LAUNDRY ALTERNATIVES. Myers, W. G.; Oyen, L. C. 74-WA/NE-3. New York; American Society of Mechanical Engineers (1974). 11p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The current emphasis to reduce the release of radioactive waste from nuclear power plants to the "as low as practicable" level has resulted in a concerted effort to apply the latest technology in the design and operation of the radwaste facilities at these plants. One source of liquid radioactive waste treated and processed at many of these nuclear plants results from the laundering of the protective clothing worn by personnel while working radioactive level of the laundry waste is relatively low, there are different technical options in the treatment of laundry waste and each results in several economic options that must be considered. (auth)

32217 EFFECT OF PRECURSORY COOLING ON FALLING-FILM REWETTING. Sun, K. H.; Dix, G. E.; Tien, C. L. 74-WA/HT-52. New York; American Society of Mechanical Engineers (1974). 9p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

An analytical model for falling film wetting of a hot surface has been developed to account for the effect of cooling by droplet-vapor mixture in the region immediately ahead of the wet front.

The effect of precursory cooling is characterized by a heat transfer coefficient decayed exponentially from the wet front. Based on the present model, the wet front velocity as well as the temperature profile along a thin slab can be calculated. It is demonstrated that the precursory cooling can increase the wet front velocity an order of magnitude. Existing experimental data with variable flow rates at atmospheric pressure are shown to be successfully correlated by the present model. 10 references. (auth)

32218 ANALYSIS OF CONDUCTION-CONTROLLED REWETTING OF A VERTICAL SURFACE. Tien, C. L.; Yao, L. S. 74-WA/HT-49. New York; American Society of Mechanical Engineers (1974). 9p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A two-dimensional analysis is presented for conduction-controlled rewetting of a vertical surface, whose initial temperature is greater than the Leidenfrost temperature. The physical model consists of an infinitely-extended vertical slab with the surface of the dry region adiabatic and the surface of the wet region associated with a constant heat transfer coefficient. The physical problem is characterized by three parameters: the Peclet number or the dimensionless wetting velocity, the Biot number, and a dimensionless temperature. Limiting solutions for large and small Peclet numbers obtained by utilizing the Wiener-Hopf technique and the kernel-substitution method exhibit simple functional relationships among the three dimensionless parameters. A semi-empirical relation has been established for the whole range of Peclet numbers. The solution for large Peclet numbers possesses a similar functional form as existing approximate two-dimensional solutions, while the solution for small Peclet numbers reduces to the existing one-dimensional solution for small Biot numbers. Discussion of the present findings has been made with respect to previous analyses and experimental observations. 13 references. (auth)

32219 UNSTEADY PHENOMENA RELATING TO VAPOR SUPPRESSION. Saito, T.; Uchida, H.; Morita, T.; Oishi, T.; Saito, S. 74-WA/HT-47. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A pressure suppression chamber is utilized to quench the energy released from the reactor pressure vessel to the container in case of a loss-of-coolant accident. In order to understand the unsteady process in water vapor condensation, simple models were experienced using water or refrigerant R-113. Three sorts of phenomena: (1) vibration of fluid column in a vertical tube; (2) sudden pressure drop and rapid elevation of water in a vertical tube; and (3) surface wave of liquid in container which is excited by vapor bubbles, are reported. 5 references. (auth)

32220 NUCLEAR POWER PLANTS AND THE ENVIRONMENT. Faure, M. (Electricite de France, 75 - Paris). Kerntechnik; 16: No. 11, 490-493(Nov 1974).

The consumption of electric power will continue to increase in Europe and, in particular, in France where an increasingly greater proportion of the demand will be covered by nuclear power. Among the various environmental consequences of the construction of nuclear power stations, some must remain permanently a concern of the owners of these power stations, namely: waste heat dumping, radioactive effluents, nuclear wastes, and the safety of nuclear power plants both in normal operation and in the event of accidents. (auth)

32221 RELEASE OF FISSION PRODUCTS FROM THE CORE OF A PRESSURIZED WATER REACTOR UNDER LOSS-OF-COOLANT ACCIDENT CONDITIONS. Mattila, L. J.; Ollikkala, H. (Technical Research Centre of Finland, Otaniemi. Nuclear Engineering Lab.). pp 33-56 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Analytical studies have been made to assess the extent and time history of the release of noble gases, iodine and certain other fission products from the core of a WWER-440 PWR under different LOCA conditions. The pre-accident release of fission products to the fuel rod voids, the time history of the puncturing of fuel rods, and the release of fission products from the overheated fuel during the accident phase are evaluated. The main variables considered were: fuel irradiation history, relationship between accident and refuelling times, release model parameters and the detail of core modelling. With the present methods and available empirical data conservative analyses tend to yield results which are greater than those of realistic analyses by a factor of at least ten. (FR)

32222 FORMATION OF GASEOUS EFFLUENTS IN NUCLEAR REACTORS. Gey, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes de Surete Radiologique). pp 15-32 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Nuclear reactors form inert or radioactive gaseous fission products. These gases inflate fuel elements. Their activity decreases, as soon as they are withdrawn from the neutron flux. The gases follow various paths and are released in reprocessing plants. During their life, they can accidentally occur within varied containment vessels. The values proposed allow the assessment of formed quantities of available volumes and of residual nuisances according to any deemed time after irradiation; they allow as well a first step approach assessment of nuclear plant safety. (FR)

32223 GASEOUS, LIQUID AND SOLID WASTES DISCHARGED FROM NUCLEAR POWER-PLANTS OF ELECTRICITE DE FRANCE. Martin, J. J.; Chaperon, B. (Electricite de France, 93 - Saint-Denis. Dept. de Radioprotection). pp 611-621 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Operation by Electricite de France of nuclear power plants of various types (gas-cooled and graphite-moderated, gas cooled and heavy water moderated, pressurized water reactors) induces gaseous and liquid wastes of variable importance due to operating circumstances of the plant of the connected waste treatment. Confinement of liquids seems easy to be performed and that allows to look only on voluntary tank drainages. On the other hand confinement of gaseous wastes is much more difficult and leakages of active gas cannot be prevented through ventilation air. Long-time storage of gaseous wastes is unwarranted in power plants as long as long half life gaseous activity will remain a trifling part of activity released during the whole fuel cycle. If the efficiency of waste treatment and the production of solid wastes is great, the public exposure is reduced but the consequent doses for people working under radiations may be high. Another important source of solid wastes is comprised of slightly contaminated materials coming from maintenance work on secondary circuits of which origin does not authorize throwing out as inactive refuse and for which a solution must be found. (FR)

32224 SIMULATION OF A FUEL HANDLING ACCIDENT IN A PWR REACTOR. Porcheron, J ; Michel, R. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Service d'Etudes de Surete Radiologique). pp 147-158 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The fuel unloading of a PWR reactor requires the opening of the primary circuit. The fuel is transported under the water of the storage pool. The water becomes the only barrier against the fission products in the case of a handling accident. The experiment is made to determine the efficiency of this barrier. Gaseous molecular ^{131}I is injected under 3 meters of water. The injection pressure is 80 bars. The system provides capability to inject the contamination in a very short time. Iodine injection is made by using a device including a previous storage of the activity on carbon dioxide ice. Measurements of water and air contamination show that the part of iodine passing through the water is weak ($^{1}/_{415}$). The complete breaking of the fuel assembly was simulated. (FR)

32225 SUPER-PHENIX CONTAINMENT SYSTEM AND ENVIRONMENTAL IMPACT. Chalot, A. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Malaval, C. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92 - Le Plessis-Robinson (France)); Rodet, E.; Lucenet, G. (Electricite de France, 69 - Lyon. Region d'Equipement). pp

263-281 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The precautions which are undertaken for preventing the effects of missiles are shown: the behavior of the containment system to earthquakes is discussed. The arrangements considered against sodium fires of main components of the reactor are discussed. Finally a hypothetical accident has been considered which involves the fuel melting and the sodium–fuel interaction phenomenon: in this case, the containment system includes essentially an intermediate barrier, a primary and a secondary barrier. It is completed by an emergency cooling system and by a core catcher. (FR)

32226 VOLATILE RADIOIODINE RELEASED IN SODIUM POOL BURNING. Kitani, S.; Takada, J.; Nishio, G.; Shiratori, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 115-128 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

In the sodium pool burning of a sodium cooled reactor, some radioiodine is transported from the liquid sodium to the gas phase with the sodium oxide aerosol. However, if the radioiodine is partially converted to volatile compounds, the radioactivity may remain in the reactor containment with long life. Experiments have been made to study whether volatile radioiodine compounds generate in sodium fire. Sodium iodine tagged with ^{131}I in about 1 ppm was mixed with purified sodium; which was then burned by heating in the air. The iodine released in the air mainly consisted of the aerosol, but some was found to be in a volatile state, which remained in suspension for many hours. The volatile iodide was shown to be organic by May Pack and radio-gaschromatography techniques. (auth)

32227 REMOVAL OF IODINE FROM CONTAINMENT ATMOSPHERE BY SPRAYS: RESEARCH AT THE UNIVERSITY OF PISA. Barsali, S.; Bovalini, R.; Fineschi, F.; Guerrini, B.; Lanza, S.; Mazzini, M.; Mirandola, R. (Pisa Univ. (Italy). Istituto di Impianti Nucleari). pp 341-357 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The Istituto di Impianti Nucleari of the University of Pisa is carrying out since 1967 an experimental research program to study the removal of molecular iodine from containment atmosphere by sprays. Twelve experimental runs have been made at the PSICO-10 facility in a 95m^3 model containment vessel. The results have been analyzed and compared with those obtained by other research organizations. This analysis has been performed with the aim of gathering data for the evaluation of DRF_{2h} attributed to the nuclear power plant spray systems in case of loss of coolant accident. The results of such an analysis have shown that, with the hypotheses of the USAEC regulatory guides, values of DRF(2h) are in the range 8-10. (FR)

32228 THERMAL CONSEQUENCES OF SODIUM FIRES IN A LMBFR, APPLICATIONS TO SUPER-PHENIX REACTOR. Chalot, A. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Fourest, B. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92 - Le Plessis-Robinson (France)); Colome, J.; Duco, J.; Malet, J. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). pp 315-340 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Thermal consequences of two types of sodium fire in a LMFBR containment are analyzed: sprayed primary sodium fire, following a hypothetical explosive accident with loss of tightness of the top closure of the primary vessel; pool secondary sodium fire following a large break on a secondary pipe. In the two cases, the accident produces temperature and pressure rise which may jeopardize containment tightness. Evaluation of the consequences of these fires supposes knowledge of some phenomena and determination of numerical values of some characteristic parameters. Burning rates, reaction mechanism and energetic balance are specially analyzed in two types of experiments. These experiments have procured some numerical values and calculation hypothesis for determining the thermodynamical specifications for the dome and the secondary containment of Super Phenix Reactor. (FR)

32229 SOME CONSIDERATIONS CONCERNING CONTAINMENT FOR NUCLEAR POWER REACTORS. Beattie, J. R. (UKAEA Safety and Reliability Directorate, Culcheth). pp 251-262 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The consequences to the environment and to the population of nominal releases from national accidents to thermal neutron reactors are outlined and contrasted with the much more serious consequences which could result from realistically conceived accidents to thermal neutron and fast neutron reactors. The imperative need to prevent the occurrence of these accidents and to contain any release of activity from them is re-emphasized. (FR)

32230 TRITIUM IN PRESSURIZED LIGHT WATER NUCLEAR POWER PLANTS. Dolle, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Analyses et d'Etudes en Chimie Nucleaire et Isotopique). pp 57-78 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Several sources of very different importance are responsible for tritium generation in the pressurized-water primary circuit of light-water power plants. In a pressurized-water reactor employing boron shim control, the neutron absorption in boron is the principal source in the primary water; tritium coming from ternary fission in the fuel diffuses out of the pins only in negligible amounts if the canning material is zircalloy. The leakage rate of the primary circuit limits the value of the tritium equilibrium concentration in the water. Nevertheless in a hypothetical 1000MW(e) reactor, dilution of the primary water in the pool, during refueling may lead to tritium concentrations at water surfaces in contact with the free atmosphere in the reactor containment becoming harmful under certain temperature conditions. The increase of tritium concentration in primary circuit and pool water is estimated, as a function of the primary circuit leakage rate and different programmed organized annual releases. These organized releases represent a simple way to decrease the tritium concentration resulting from several annual operating cycles to acceptable levels. The amount of tritium generated annually by ternary fission and remaining in the fuel, is much greater than the total production in primary water. Thus the estimation of tritium contamination in the environment has to take into account both nuclear power plants and the corresponding fuel reprocessing plants. It is essential to extract tritium in the reprocessing plants; the available procedures have become almost classical by now. Organized releases of reactor water containing tritium seem still practicable, except in the case of more severe local restrictions. Tritium extraction from reactor water would be a difficult problem because of the small concentrations involved, making it necessary to develop new separation processes. (FR)

32231 INVESTIGATION ON THE DYNAMICS OF THE REACTOR OF THE NUCLEAR POWERED SHIP OTTO HAHN. P. 2. Fiebig, R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany). Inst. fuer Physik). Atomkernenergie; 24: No. 2, 111-116(1974). (In German).

A representation is given of the moderator reactivity of the FDR reactor as a function of the thermodynamic parameter of the reactor core with partial boiling. The validity of the representation at 40 to 150% power and 40 to 100% coolant flow is demonstrated. Calculations of the dynamic behavior of the reactor during reactivity perturbations yield the same accuracy of 20% with experiment as obtained earlier. Systematic deviations, however, appeared in long time experiments which also showed secondary power perturbations. Earlier accident calculations were repeated and showed to be on the conservative side. (auth)

Reactor Theory and Calculation

Refer also to abstracts 29671, 31327, and 31451.

32232 (BNL-19302) CROSS SECTION EVALUATION WORKING GROUP BENCHMARK SPECIFICATIONS. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1974. Contract AT(30-1)-16. 179p. (ENDF-202). Dep. NTIS $12.00.

The utilization of integral experiments has been widely accepted by the CSEWG community as a mechanism for validation of the ENDF/B data files. Over the past half dozen years a number of fast integral experiments have been given recognizance as CSEWG Fast Reactor Benchmarks. This report represents an attempt by the CSEWG community to present specifications for the currently accepted Fast Reactor Benchmarks systematically. Specifications for these benchmarks conform to an aggreed upon format. All accepted benchmarks have been reviewed for completeness and accuracy of experimental information. The following fast reactor benchmarks are included: JEZEBEL, VERA-11A, ZPR-3-48, ZEBRA-3, GODIVA, VERA-1B, ZPR-3-6F, ZPR-3-11, ZPR-3-12, ZEBRA-2, ZPPR-2, ZPR-6-7, ZPR-3-56B, SEFOR, and ZPR-6-6A. The CSEWG Shielding Benchmarks have been published; only a compilation of references is given for these. The validation of nuclear data files in the calculation of thermal reactor benchmarks is also an important objective. The following thermal reactor benchmarks are discussed: ORNL-1, ORNL-2, ORNL-3, ORNL-4, and ORNL-10, TRX-1, TRX-2, TRX-3, TRX-4, MIT-1, MIT-2, MIT-3, PNL-1, PNL-2, PNL-3, PNL-4, and PNL-5. (RWR).

32233 (FEI-435) ERRORS IN DETERMINATION OF POWER OF REACTOR TECHNOLOGICAL CHANNELS. Goryunov, V. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 22p. (In Russian). INIS.

In the operation of power reactors wide use is made of calculating channel power by density interpolation of the magnitude of the macrofield energy given off as recorded on reactor instruments. Both the allowable power level of the entire unit and safe reliable conditions of reactor operation depend a great deal on the magnitude of the error of this calculation. Problems in calculating the error which arises in determining channel power are considered. From the relationships obtained it is possible to estimate the interpolation accuracy as a function of the channel coordinates, the error of the recorders, and the statistical properties of the field of energy that is evolved. These relationships can be used in designing control systems of energy evolution for determining the number of recorders, and also in analyzing the error of these systems on operating reactors. As an example a calculation is made of the error in determining the channel power of a Beloyarsk reactor from readings of recorders, and the possible economic effect from using the control system is presented. (tr-auth)

32234 (LA-UR-75-318) FISSION-PRODUCT GAMMA-RAY PHOTONEUTRON SPECTRA. Stamatelatos, M. G.; England, T. R. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-Eng-36. 7p. (CONF-750303-42). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Fission-product gamma-ray and photoneutron spectra from thermal and fast fission of ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu have been calculated at 27 time intervals between 1 and 1000 hours following reactor shutdown. The gamma spectral calculations were made using CINDER, a depletion and fission-product code, which has been revised, extended, and variably dimensioned for applications to many problems involving irradiated materials. ENDF/B-IV yield and decay data for all fission products with half-lives $\geq$ 15 minutes and gamma energies above $^{9}Be(\gamma,n)^{8}Be$ threshold were used. An interesting general feature of the spectra is that they harden with time. The photoneutron spectra were calculated with PHONEX, a program general enough to operate on arbitrary gamma spectra incident on specific materials, e.g., ^{9}Be and ^{2}H. Time-dependent distributions of photons and photoneutrons/fission were calculated in 66 energy groups (50 keV grids). The constancy of these source strengths between ~ 10 and 200 hours following reactor shutdown indicates the possibility of sourceless start-ups. (11 references) (auth)

32235 PROMPT NEUTRON DECAY CONSTANT IN A COUPLED CORE THERMAL REACTOR. Lazarescu, G. A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 5, 555-558(1974).

Prompt neutron decay constant measurements carried out in an Argonaut reactor are described. The pulsed source technique was used. An asymmetric source position was chosen, and enriched BF_3 counters were used in conjunction with multichannel analyzers. Experimental results are presented. (DG)

32236 CHF PREDICTION FOR SQUARE ARRAYS BY THE BUNDLE ENTHALPY IMBALANCE METHOD. Hughes, E. D. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)); Pischer, K. H.; Carbon, M. W. (Wisconsin Univ., Madison (USA)). Nucl. Eng. Des.; 31: No. 2, 260-265(1974).

For both economic and safety reasons, the reactor designer should be able to predict accurately the conditions under which critical heat flux (CHF) is reached. Consequently, extensive experimental and analytical studies have been carried out in many nations. Laboratory work is discussed which involved tests on round tubes, annuli, rod bundles having from three to at least 49 rods, and other geometries. Very accurate data have been obtained. The McPherson method for CHF prediction for rods in square channels or arrays is evaluated. (auth)

32237 OPTIMAL DESIGN OF A REFLECTED-CORE NUCLEAR REACTOR. Lam, F. Y.; Townsend, M. A. 74-WA/DE-13. New York; American Society of Mechanical Engineers (1974). 5p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Optimal results are presented for the design of a reflected-core spherical reactor. Complete model development is given. The result is a highly nonlinear system with 2 equality and 13 inequality constraints. Substantial savings in core and reflector materials are indicated; from this, investigation for similar savings in more complex models of present-day reactors (cylindrical core, multigroup theory) is suggested. Because of the model complexity and nonlinearity, a special direct-search algorithm based on the Flexible Tolerance Search was developed. 5 references. (auth)

32238 MODELED THEORY OF PULSED-NEUTRON EXPERIMENTS IN FAST SUBCRITICAL ASSEMBLIES. Adalioglu, U. (Cekmece Nuclear Research Center, Istanbul); Duderstadt, J. J. Transp. Theory Statist. Phys.; 3: No. 2-3, 147-166(1973).

The time behavior of a neutron pulse in a fast subcritical assembly is modeled by approximating the spatial dependence by a single diffusion mode and using a simple model of inelastic scattering. This model allows an explicit calculation of the time response of a detector in such a system. Of particular interest is a study of the detector response in those situations in which the flux does not decay in an exponential fashion. 9 references. (auth)

32239 EFFECT OF LATERAL LEAKAGE ON NEUTRON WAVES IN POLYCRYSTALLINE MEDIA. Yamagishi, T. (Osaka Univ.). Transp. Theory Statist. Phys.; 3: No. 2-3, 107-135(1973).

The reduced three-dimensional transport equation for neutron wave propagation is solved in the velocity-dependent case with a separable scattering kernel by the eigenfunction-expansion method. The full- and half-range orthogonalities for the eigenfunctions are derived. The former is applied to solve the transport equation in an infinite system. In the case of a discontinuous total cross section, the contribution from the two-dimensional continuum in the spectral plane is reduced to an integral along the branch cut by applying the analytical continuation of the dispersion function. The effects of transverse buckling on the discrete and pseudo modes are examined by numerical calculations of the solution for beryllium and graphite. 19 references. (auth)

32240 COMSYS: A COMPUTER CODE TO DETERMINE FISSION PRODUCT INVENTORIES AND RELATED QUANTITIES. Gileadi, A. E.; Musalem, A. (Puerto Rico Nuclear Center, Mayaguez; Puerto Rico Univ., Mayaguez). pp 99-113 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The objectives, methods and scope of COMSYS, a computer code designed to calculate fission product inventories and related quantities used for the evaluation of safety, heat balance, as well as certain biological and environmental effects associated with the operation of nuclear reactors, are described. The basic option of COMSYS uses the build-up equations to determine number densities of individual fission products present in irradiated fuel. Besides the operating history and certain relevant reactor parameters, COMSYS uses an input data file including: fission yield tables; detailed decay characteristics of all precursor chains considered; and to relevant neutron cross sections. The output of the basic option contains operating history dependent number densities of all fission products along with energies and intensities of the beta and gamma radiation emitted by each. (FR)

32241 PERTURBATION THEORY OF VARIOUS APPROXIMATIONS IN STEADY-STATE NEUTRON TRANSPORT. Pupko, V. Ya. Sov. At. Energy (Engl. Transl.); 37: No. 1, 742-744(Jul 1974).

Translated from At. Energy.; 37: No. 1, 63-65(Jul 1974).

Perturbation theory calculations of neutron physics problems are frequently limited to the first approximation. A general method for constructing perturbation theories of various approximations is discussed. A perturbed eigenfunction of the neutron flux is expanded in terms of the eigenfunctions of the quasi-stationary neutron transport equation for the unperturbed medium. The treatment of this problem is presented. 5 references. (auth)

32242 PROBLEM OF CALCULATING A POLYCELL IN P_3-APPROXIMATION. Galanin, A. D.; Smelov, V. V.; Torlin, B. Z. Sov. At. Energy (Engl. Transl.); 37: No. 1, 762-763(Jul 1974).

Translated from At. Energ.; 37: No. 1, 76-77(Jul 1974).

For the one-velocity calculations of complex cells in P_3-approximation certain differences are suggested between the procedure itself. The neutron field both inside the slug and outside of it, down to a certain arbitrary limit and differing from the field of the adjoining slugs is described by a series which takes into account certain azimuthal harmonics of the field. The field of the adjacent slugs is approximately (on average) "matched" to this arbitrary limit. It is assumed that the "inherent" field of every slug possesses cylindrical symmetry. The neutron field outside of the slugs is equal to the sum of the intrinsic field of all slugs of the lattice, and therefore they depend on the azimuthal angle. A series of calculations was carried out on several variants of a double hexagonal lattice with a 1:3 ratio of the number of slugs of first and second type. Both slugs are circular, with external and internal radii of the ring 2.5 and 2 cm respectively. The moderator inside and outside of the ring was assumed to be nonabsorbing with a scattering length of 2.5 cm. The scattering length of the material of the ring-shaped slugs was assumed equal to 10 cm. (auth)

32243 NOTE ON THE ADJOINT FUNCTION IN TIME DEPENDENT REACTOR THEORY. Ronen, Y. (Israel Atomic Energy Commission, Beersheba). Ann. Nucl. Sci. Eng.; 1: No. 9/10, 513-515(Sep 1974).

The integral over time of some local density is found. The method is based on solving stationary regular and adjoint equations. It is applied to a problem from time dependent reactor theory and tested by a numerical example. (auth)

32244 FINITE ELEMENT METHODS IN REACTOR PHYSICS ANALYSIS. Hansen, K. F.; Kang, C. M. (Massachusetts Inst. of Tech., Cambridge). Advan. Nucl. Sci. Technol.; 8: 173-253(1975).

Information is presented on the development of the finite element method, piecewise polynomial spaces, neutron spectrum calculations, static diffusion problems, and time-dependent problems. 35 references. (DCC)

32245 EVALUATION OF INTEGRAL PHYSICS EXPERIMENTS IN FAST ZERO POWER FACILITIES. Kiefhaber, B. (Kernforschungszentrum, Karlsruhe, Ger.). Advan. Nucl. Sci. Technol.; 8: 47-113(1975).

Information is presented concerning the accuracy of nuclear data used for reactor calculations, implications of nuclear data uncertainties, role of integral experiments in improving the nuclear data basis, and status of evaluation efforts. 167 references. (DCC)

Reactor Components and Accessories

Refer also to abstracts 29734, 30097, 30149, 30163, 30185, 31773, 32227, and 32345.

32246 (AED-CONF-74-538-001) ULTRASONIC TESTING EQUIPMENT AND DATA PROCESSING FOR FIRST AND IN-SERVICE INSPECTIONS OF REACTOR PRESSURE VESSELS. de Raad, J. A.; Dijkstra, F. A.; Engl, G. (Roentgen Technische Dienst N. V., Rotterdam (Netherlands)). 1974. 11p. (In German). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

18 figs.; 6 refs.

A rational performance of testings of this kind using multichannel equipment can contribute to reducing the time required for testing to a minimum. The use of suitable 1 MHz-heads considerably weakens the interfering cladding effects (such as sound attenuation, surface properties). The entire testing equipment described (US-apparatus, manipulator, data recording unit) enables tests to be made which are largely reproducible and whose results are recorded systematically so that comparison of data with subsequent in-service inspection measurements is relatively easy. (GE)

32247 (AED-CONF-74-538-027) REMOTE MAINTENANCE OF NUCLEAR STEAM GENERATORS. Stark, L. E.; Brown, E. L.; Johnson, W. R. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research Center). 1974. 11p. (RDTPA-74-22). INIS.

From 2nd international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

11 figs.; 2 tabs.; 1 ref. Available from ZAED.

Recent achievements in explosive plug welding and, more specifically, the progress made in developing a repair procedure for sealing an internally placed sleeve over the source of a leak are described. (auth)

32248 (IRS-T-21, pp 134-143) STRESS ANALYSIS OF REACTOR COMPONENTS WITH THE FINITE ELEMENT METHOD. Miksch, M. Mar 1974. (In German).

From VsTUeV/IRS-colloquium; Koeln, F. R. Germany (20 Mar 1973).

14 figs.; 11 refs.

In finite-element method in the evaluation of structural components.

The finite element method has proved to be very accurate calculation method in stress analysis in reactor construction. This is demonstrated by three examples of application: 1) Three-dimensional calculation of the main coolant nozzle of a reactor pressure vessel, 2) cylindrical part of the reactor pressure vessel with peripheral crack under thermal shock, 3) primary chamber of a steam generator under internal pressure. The results of the FEM are compared with other methods. Deviations are discussed. (GE)

32249 (IRS-T-21, pp 144-152) FINITE-ELEMENT PROGRAMMES AS A TOOL FOR THE ANALYSIS OF REACTOR COMPONENTS. Sachs, K.; Andersen, H. Mar 1974. (In German).

From VdTUeV/IRS-colloquium; Koeln, F. R. Germany (20 Mar 1973).

9 figs.

In finite-element method in the evaluation of the structural components.

A review is presented of the possible applications of large finite element programs such as STARDYNE, ASKA, NASTRAN, SAP and MARC CDC for the calculation of the temperature field and the treatment of non-linear processes. (GE)

32250 (ORNL-tr-2913) INTERNAL PRESSURE STRESS ANALYSIS OF PCPV FOR A NUCLEAR POWER STATION. Ujiie, K.; Murata, T.; Takase, H.; Masuda, K. Translated by H. Kubota from Kajima Kensetsu Gijutsu Kenkyusho Nempo; 18: 379-384 (1969). 11p. Dep. NTIS $4.00.

The results of the analysis indicate that large tensile stresses are created at the following sites constituting problems that have to be considered in the design: stress in the z direction at the outer central wall surface of the cylinder section; stress in the circumferential direction at the inner cylinder section; and stress at the inner wall surface at the junctions between the cylinder and covers. (4 references) (auth)

32251 (ORNL-tr-2914) INTERNAL TEMPERATURE STRESS ANALYSIS OF PCPV FOR A NUCLEAR POWER STATION. Ujiie, K.; Murata, T.; Takase, H.; Masuda, K. Translated by H. Kubota from Kajima Kensetsu Gijutsu Kenkyusho Nempo; 18: 385-392 (1969). 11p. Dep. NTIS $4.00.

The temperature distribution resulting from the application of a temperature differential of 50°C between the inner and outer wall surfaces of the basic model was calculated, and it was found that large stresses were created at the following points: tensile stress at the outer wall surface in the rz plane particularly in the cylinder section and inner wall surface in the circumferential direction; and compressive stress at the inner wall surface in the rz plane and outer wall surface in the circumferential direction. (3 references) (auth)

32252 (ORNL-tr-2915) STRESS ADJUSTMENTS USING PRESTRESSING TENDONS FOR THE PCPV OF A NUCLEAR POWER STATION. Ujiie, K.; Murata, T.; Takase, H.; Masuda, K. Translated by H. Kubota from Kajima Kensetsu Gijutsu Kenkyusho Nempo; 18: 393-398(1969). 11p. Dep. NTIS $4.00.

The method of analysis for the situation in which prestressing was introduced into the PCPV and an example of analysis of a basic model along with the method of adjusting stresses in the design are discussed. (4 references) (auth)

32253 NUCLEAR REACTOR MATERIALS-DEVELOPMENT WITH AN EYE ON SAFETY. Oestberg, G. (Aktiebolaget Atomeergi, Studsirk, Sweden). Tek. Tidskr.; 104: No. 15, 18-21(4 Oct 1974). (In Swedish).

Reactor materials development is at present primarily concerned with the improvement of safety, reliability, and economy.

In fast reactors, for example, swelling of core material is a problem which will become even more difficult to resolve when the designing of the jacket of a fusion reactor is faced. Intensive research is being conducted to investigate fuel element performance and crack in reactor vessels and heat-exchangers. Interest is growing in high temperature reactors. New materials are required for fast reactors. It is difficult to predict what materials will be suitable for fusion reactors. (SW)

32254 ASSESSMENT OF BOUNDS ON STRESSES AND STRAINS IN PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Irving, J. (Central Electricity Generating Board, Cheltenham, Eng.); Carmichael, G. D. T. Mag. Concr. Res.; 25: No. 85, 189-196(Dec 1973).

The significance of the mechanical behavior and condition of concrete for the stresses and deformations in prestressed concrete reactor pressure vessels is discussed with reference to the loading history. Approximate solution techniques for stress and strain analysis currently in use are described briefly and their relative merits discussed. Earlier work has shown that it is important, when evaluating vessel stresses and deformations occurring over a long period of time, to take into account the effect of previous loadings upon the capacity for creep under subsequent loadings. To determine this effect by simple means, an approximate uniaxial strain response function is used to derive curves from which the transient stress behavior due to creep in unreinforced and reinforced prestressed concrete structures can be determined. It is deduced that, although bounds on stress can be derived for reactor start-up conditions (an initial elastic solution), and for long-term reactor operation (a steady-state solution), the creep capacity may not be sufficient for the long-term bound to be approached very closely. If this is not appreciated, an unduly pessimistic view of long-term vessel stresses could be obtained. (auth)

32255 TEMPERATURE AND STRESSES IN A BOILER MEMBRANE WALL TUBE. Di Pasquantonio, F. (Ente Nazionale per l'Energia Elettrica, Milan (Italy)); Macchi, A. (Applicazioni e Ricerche Scientifiche, Milan (Italy)). Nucl. Eng. Des.; 31: No. 2, 280-293(1974).

Analysis of thermal and stress fields in membrane wall tubes is approached by means of finite difference and finite element codes. The most important results obtained concern the heat flux distribution law, the evaluation of the heat transfer coefficient, the choice of appropriate boundary conditions in stress calculations, and the influence of the web on the stresses in the tube. All stress fields have been determined in the framework of linear elasticity theory. However, considering the high range of temperatures, it is required to extend the analysis into the range of creep behavior. (auth)

32256 ASSESSMENT OF KINEMATIC HARDENING THERMAL RATCHETING. Mulcahy, T. M. 74-Mat-M. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

Analytical comparisons are made between the thermal ratcheting response of a kinematic hardening material, a perfectly plastic, and an isotropic hardening material for a two-element assembly. Significant differences were found in the range of mechanical and thermal loading for which ratcheting occurred and the magnitude of the strain accumulation when ratcheting did occur. The kinematic hardening strain accumulation predicted was always smallest. 7 references. (auth)

32257 ATOMIC POWER IS UNDERMINING THE ASME BOILER CODE FOR PUBLIC SAFETY. Ackerman, A. J. 74-WA/TS-3. New York; American Society of Mechanical Engineers (1974). 29p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The old insignia of The American Society of Mechanical Engineers, when stamped on potentially explosive equipment, such as high pressure steam boilers, stand as symbols for engineered public safety and for nationwide public confidence. This confidence is the reward for the integrity and responsibility demonstrated in more than 50 years by mechanical engineers, inspectors, manufacturers, and operators of insured steam boilers. In essence, this confidence is a prized national heritage, and it is not transferable by a simple decree of edict. It can only be earned. 20 references. (auth)

32258 ANALYSIS OF POWER PLANT SAFETY AND RELIEF VALVE VENT STACKS. Liao, G. S. 74-WA/Pwr-3. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Power plant safety and relief valve vent stacks have generally been sized according to the methods and design criteria published by Max W. Benjamin in the 1940s. Although the method might have been satisfactory at that time utilizing basic flow dynamics, it not only requires laborious calculations, but also contains some inadequate approaches which may contradict the theory of compressible fluid mechanics available today. A complete analysis of steam conditions and its properties from power plant safety/relief valve inlet through its vent stack to the atmosphere is presented. The analysis is based on the theory of compressible fluid flow under irreversible adiabatic process to establish a method and criterion for vent stack design. The method developed herein is applicable to both choking and nonchoking conditions at the valve exit and/or vent stack outlet, and greatly reduces complex trial-and-error solution. Furthermore, an accurate determination of fluid conditions will facilitate the calculation of reaction forces on safety/relief valve and its stack. The results of sensitivity analyses to verify the validity of applying perfect gas equations to steam are presented. 9 references. (auth)

32259 VERIFICATION OF A QUASI-STATIC ELASTIC-PLASTIC IMPACT ANALYSIS FOR A CHECK VALVE USED ON A NUCLEAR PIPING SYSTEM. Leonard, J. W.; O'Leary, J. R. 74-WA/PVP-8. New York; American Society of Mechanical Engineers (1974). 9p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A quasi-static elastic-plastic technique employing the finite-element method for the impact analysis of a swing type check valve under a steam line break is described. The conservative nature of the technique is verified for a specific valve geometry by comparison to a non-linear time-dependent finite-difference simulation for a particular velocity of closure. 11 references. (auth)

32260 VACUUM CONTAINMENT SYSTEMS FOR MULTI-UNIT NUCLEAR POWER STATIONS. Fee, E. W.; Shaw, G. E. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). pp 283-306 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

In multi-unit plants an evacuated reservoir equal approximately in volume to the reactor building and connected to it by a large duct provides a particularly effective means of reducing peak reactor building pressure. The cost saving on each of the reactor buildings more than offsets the cost of the vacuum building. The design, testing, cost advantages of vacuum containment systems for multi-unit stations and the principal performance features of the system (building pressure transients, and dousing utilization), are described. (FR)

32261 PHILOSOPHY OF HEALTH PHYSICS MEASUREMENTS IN LIGHT WATER REACTORS OF ELECTRICITE DE FRANCE. Martin, J. J ; Beau, P. (Electricite de France, 93 - Saint-Denis. Dept. de Radioprotection); Bouzon, B. (Electricite de France, 92 - Clamart. Region d'Equipement). pp 469-479 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Health physics measurements in a nuclear plant must be designed in sympathy with workers and public protection rules. On the other hand, one must inquire into proper means for checking the tightness of barriers between active primary water and environment. These barriers may be tight or pervious (filters). Owing to difficulties inherent in these controls and low desirable alarm threshold, detectors have only an alarm function, without any measurement purpose. Quantitative evaluation of leakages seems to be obtained generally only through laboratory sample analyses, except if sophisticated instrumentation is set up. Fixed radiation monitoring forecasted for new pressurized water plants under construction for Electricite de France is reviewed. (FR)

32262 A HOLLOW-WALL DEFORMABLE RING AND A METHOD FOR MANUFACTURING SAME. Moulin, M.; Roze, M.; Vivien, J. (to CEA, 75 - Paris (France)). French Patent 2,191,633/D/. 3 Jul 1972. 10p. (In French).

The description relates to a hollow-wall deformable ring adapted to act resiliently. This ring is in the shape of a hollow annulus of revolution formed of two coaxial walls, viz an inner wall and an outer wall, connected by two semitori coaxial with these walls, each of the latter being provided with recesses evenly distributed along its periphery. These recesses have their axes in parallel relationship with the annulus axis and are

of a length slightly greater than half the annulus breadth. The recesses open alternately into either of the two semi-tori. This ring can be used for heat-proofing purposes and for generating pre-stresses. (FR)

32263 A SEALING DEVICE MOUNTED BETWEEN TWO WALLS. (to Societe Creusot-Loire, 75 - Paris (France)). French Patent 2,194,283/D/. 26 Jul 1972. 7p. (In French).

The description relates to a sealing device mounted between two walls slightly movable with respect to each other and forming a portion of an annulus the extremities of which are respectively fixed to the wall edges, this device which is formed of superimposed layers of elements being characterized in that an element comprises at least one thin metal-sheet adjacent to at least one web formed of at least one layer of metal grid, in that two metal sheets of one given element are mounted end-to-end with their edges partially overlapped, and in that two metal-grid webs of one element are mounted end-to-end with a slight clearance between the edges thereof. (FR)

32264 DE-SUPERHEATING TERMINAL DEVICE FOR STEAM BY-PASSING DEVICES. (to Societe des Condenseurs Delas, 75 - Paris (France)). French Patent 2,180,426/E/. 13 Apr 1972. 5p. (In French).

This de-superheating device is characterized in that the expansion chamber, or chambers are each associated with two pulverization, or spraying, chambers located on either side of the expansion chamber, or chambers, and in that each of the expansion chambers is partially separated from the two spraying chambers by means of a "screen mask", the cross section of which is arcuate, crescent-shaped or circular and the curvature radius of which is smaller than that of the outer enclosure. The invention is applicable, in particular, to de-superheating terminal devices for steam by-passing devices in nuclear plants. (FR)

32265 AMELIORATION OF IODINE TRAP TESTING IN NUCLEAR PLANTS. Lasseur, C.; Troesch, G.; Andreucci, P.; Gaudiau, J.; Lelievre, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service de Protection Contre les Rayonnements). pp 359-380 of The Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

The retention efficiency of iodine traps installed on gaseous rejection circuits of nuclear plants decreases with time. Then it is necessary to control these traps periodically. The controls can be carried out either by direct methods (in situ tests) or by indirect methods (reference trap connected in parallel on the main filter). Difficulties that occurred during manipulations of charcoal samplers which are used till new in CEN-FAR and some economy considerations have led to study and realize a new model of charcoal sampler. New charcoal samplers and associated testing bank are described. The improvements and the various advantages of their use are emphasized: manipulation facilities; increased efficiency and tightness; improved detection threshold; low cost; application to the environment control. (FR)

32266 DESIGN OF CHARCOAL BEDS FOR RADIOIODINE TRAPPING. Davis, R. J. (NUS Corp., Rockville, Md. (USA)). pp 381-399 of the Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh International Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

Available data are correlated on the basis of a mass transfer model to indicate combinations of values of bed depth, granule size and air velocity which can provide required trapping efficiencies. The effects of humidity and charcoal impregnant on charcoal activity for CH_3I are included. Available data pertaining to poisoning by continuous service are correlated to provide a working equation. The two relationships are combined to provide design guidance. Two illustrative design problems are considered. One is the design of a standby containment absorber and the other is the design of an absorber for continuous service for the purpose of environmental protection. (FR)

32267 A SAFETY DEVICE PROVIDED WITH A DIAPHRAGM. Andro, J.; Fleury, A.; Pouderoux, P.; Salon, G. (to Societe Stein Industrie, 75— Paris (France)). French Patent 2,192,677/F/. 13 Jul 1972. 6p. (In French).

A diaphragm safety device is described which comprises a diaphragm adapted to be ruptured by a fluid pressure, a movable support member adapted to prevent the diaphragm to be ruptured so long as it is applied against the latter, and means for maintaining that support member in a position in which it is applied against the diaphragm with the means being released by a force exerted by the diaphragm on the support member whenever that force exceeds a given value at least equal to the diaphragm rupture load. The support member comprises an axial passage adapted to slide along a fixed rod whose extremity facing the diaphragm is provided with a sharp pointed member. Application to a large range of pipings in the nuclear field is possible. (FR)

32268 STEAM-DRYING DEVICE, IN PARTICULAR FOR THERMAL POWER STATIONS. (to Societe Babcock-Atlantique, 75-Paris (France)). French Patent 2,196,702/D/. 21 Aug 1972. 13p. (In French).

A steam drying device, in particular for thermal power stations, is described. It comprises several grids mounted side-by-side so that wet steam flows through each of them in turn, each of the grids comprising a metal wire wound around an upper and a lower suitably cross-braced parallel bar. This device can be applied in particular to the drying of steam after expansion in light water nuclear plants. (FR)

32269 MODERATOR CORE CONSTRUCTION FOR NUCLEAR REACTORS. Triggs, G. W.; Price, W. (to UKAEA London Office). German(FRG) Patent 1,300,988/C/. 29 Mar 1973. 7p. (In German).

An assembly of prismatic graphite blocks is described which are in layers and with their end surfaces layered one on top of another to supports. The blocks arranged one on top of another exhibit bores which are aligned with each other in order to form channels for fuel elements. The outer blocks are fastened to an external support by means of connecting links. (GE)

32270 IMPROVEMENTS IN POWER GENERATING PLANTS. (to Societe Babcock-Atlantique, 75-Paris (France)). French Patent 2,192,599/E/. 13 Jul 1972. 15p. (In French).

The plant comprises a steam generator and at least one steam turbine, the heat transfer between that plant and an accumulator being achieved through a coolant liquid in heat-exchange relationship with steam, a portion of which has carried out mechanical work in a turbine. The above can be applied to thermal power stations, in particular of the nuclear type. (FR)

32271 FAILED ELEMENT LOCATION IN A NUCLEAR REACTOR. Boyer, P.; Wacongne, M. (CEA, 75-Paris (France)); Pellissier, H. (Societe Industrielle de Combustible Nucleaire). (to CEA, 75-Paris (France)). French Patent 2,191,216/A/. 28 Jun 1972. 8p. (In French).

The description relates to a method for locating the rupture of fuel-pin clads by means of tracer gases. The tracer gases are enclosed in capsules of non-fusible material placed inside each of the fuel-pins, each capsule having an outwardly directed duct closed by a fusible joint adapted to melt at a temperature lower than the operating temperature of the fuel pins in the reactor, in order to deliver the tracer gases into the fuel-pins, the fusible joint being located in a constricted portion of the duct, while a non-fusible porous plug obturates the duct portion intermediate to this constricted portion and the duct outlet. This method can be applied to fast neutron reactors. (FR)

32272 PRESTRESSED CONCRETE PRESSURE VESSEL FOR A NUCLEAR REACTOR. Coast, G.; Lockett, G. E.; McIver, R. F. (to Commission of the European Communities, Brussels (Belgium)). German(FRG) Patent 1,539,887/C/. 25 Jan 1973. 11p. (In German).

A pressure vessel is described in whose vertical walls several heat exchangers are placed in perpendicularly arranged hollow spaces. The position and course of the armored cable are described with respect to the hollow spaces. (GE)

32273 RADIATION RESISTANCE PROBLEMS WITH HIGH-VOLTAGE ISOLATION OF ELECTRICAL MACHINES. Rohmer, K.; Sperling, K. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Berlin (F. R. Germany)). At. Strom; 20: No. 9/10, 108-111(Oct 1974). (In German).

The functions and the importance of electrical machines within the safety vessel of nuclear power stations are described. The radioactive radiation occurring in the containment and its effect on the serviceable life of the insulation are discussed. The physico-chemical phenomena resulting from the radiation are explained. Insulating materials are discussed which are particularly resistant to radiation. (GE)

32274 A STABLE TRACER TECHNIQUE USED TO STUDY A VESSEL CONTAINMENT. Rzekiecki, R.; Duverger de Guy, G.; Benezech, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Service d'Etudes de Surete Radiologique). pp 499-508 of the Containment of Radioactivity and the Use of Nuclear Energy. Proceedings of the Seventh Interna-

tional Congress, French Society for Radioprotection, Versailles, 28-31 May 1974. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection (1974). (In French).

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

SF_6, a gaseous stable, inert tracer, determined in subnanogramme quantities by a specific method, is released from the central point of the vessel. Samples of air are collected outside all around the walls, in the contiguous buildings, in the ventilation pipes and in the stack. The leakage rate is calculated and the real values of concentration in the surroundings, which are of great interest for the health physicists, are given as a function of time. An experiment performed to study the containment of a vessel reactor, built in a cavern, is described. Generally, such a tracer technique could be applied to study the transfer of air masses through a multiple barrier containment for various flow rates, up to the stack dispersion. (FR)

32275 EMERGENCY POWER SUPPLY IN POWER STATIONS. The Fused Busbar in Thermal Power Stations. Falderbaum, H. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Frankfurt am Main (F. R. Germany)). Elektrizitaetswirtschaft; 73: No. 24, 715-719(Nov 1974). (In German).

The emergency power supply in power plants, in particular nuclear power plants, is described regarding the most important conditions. Independence, redundancy and multiplicity of the emergency power plant in logical sequence of these requirements for the house service installation are most important demands for the safety concept. Methods of a reliability analysis and fault probability calculation are shown. Single emergency power plants for combustion power plants, conventional steam power plants and nuclear power plants are described and the safety concept is explained by means of general circuit diagrams for the emergency power circuit. The VDE conditions, VDMA standard leaflets and the DIN regulation relevant to the emergency power supply are mentioned and the most important installation systems for the emergency power supply in power plants are finally shown. (GE)

32276 BOLT CLAMPING TOOL ESPECIALLY FOR NUCLEAR REACTOR PRESSURE VESSELS. Jones, C. R. (to Transfer Systems, Inc., North Haven, Conn. (USA)). German(FRG) Patent 2,250,891/A/. 26 Apr 1973. 25p. (In German).

A bolt clamping device is described which is used to tighten and loosen the nuts on the thread bolts used to fasten the pressure head on the reactor pressure vessel. The construction details of the hydraulic controlled system are described. (GE)

32277 ACTUATING APPLICANCE FOR A GRAB ESPECIALLY FOR FUEL ELEMENTS. Mohm, F. (to Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). German(FRG) Patent 1,431,923/B/. 12 Apr 1973. 3p. (In German).

Equipment is described which permits a longitudinal movement of the grab as well as its opening and closing. The grab is operated by a shaft-sliding mechanism by means of two contractable and extendable interconnecting elements. The interconnecting elements are constructed in rows or bands or chains or racks, and two aerial drums or cogwheels are designed for them. Taking the functions as example, the single parts of the equipment are described. (GE)

32278 PRESSURE VESSEL CONSTRUCTION FOR NUCLEAR REACTORS. Kumpf, H. (to Siemens A. G., Berlin (F. R. Germany); Siemens A. G., Muenchen (F. R. Germany)). German (FRG) Patent 1,235,450/C/. 1 Feb 1973. 5p. (In German).

A pressure vessel is described which consists of a cylindrical part with lid plates on both sides which are connected to clamping devices outside the cylindrical part in order to withstand the container's internal pressure. The lid plate is clamped over supports of low thermal conductivity to steel bearers designed to fasten the clamping devices. The arrangement and properties of the steel bearers are described. (GE)

32279 CLADDING BURST DETECTION EQUIPMENT. Graftieaux, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 41-44(Sep 1974). (In French).

Most nuclear reactors are equipped with cladding burst detection equipment to check on fuel damage during operation. Two chief methods are used for this supervision according to the coolant fluid employed. With gaseous coolants (CO_2, Ar, He,...) the presence of fission gases Xe and Kr is traced by means of an electrical detector. The concentration of the fission products collected on a mobile electrode is measured with a scintillator combined with a photomultiplier or with a surface barrier semi-conductor. In the case of liquid coolants (H_2O, D_2O, Na,...) this method can only be used via a degassing system, and the detection of delayed neutrons emitted by certain short-lived fission products (I, Br, ...) is used. After slowing-down in a moderator, the neutron flux emitted is measured by ^3He or ^{10}B proportional counter tubes or fission chambers. The measurement lines which equip these instruments belong to the MULTIBLOC standard range for reactor control. (FR)

32280 RADIOACTIVE FLUID FILTRATION SYSTEMS. Gischel, E. H. 74-WA/NE-4. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A review of the role of radioactive fluid filtration equipment in the nuclear power industry; evaluation of present generic filtration systems; and introduction of a new generation of filtration equipment designed specifically to meet the radiological needs of the industry are presented. (auth)

Reactor Fuels

Refer also to abstracts 29199, 29200, 29203, 30090–30093, 30095, 30115, 30124, 30258, and 31799.

32281 (ANL-Trans-970) FISSION PRODUCT MIGRATION AND VAPOR PRESSURE IN AN IRRADIATED MIXED OXIDE. Dean, G.; Mouchnino, M.; Sauvage, R.; Schmitz, F. Jan 1975. Translation of Migration et Tensions de Apeur de Produits de Fission dans un Oxyde Mixte Irradie. (CONF-741030-10; SM-190/23). 21p. Dep. NTIS $4.25.

From symposium on thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974).

Vapor pressure measurements by the Knudsen effusion method on an oxide fuel less than one month after it was unloaded from the RAPSODIE reactor demonstrated numerous stable fission product compounds. The low partial pressures observed for cesium and iodine might be explained by the presence of oxygen-containing compounds of molybdenum in the oxide. The oxygen potentials derived from the results are compatible with a mixed oxide $(U, Pu)O_2$ close to stoichiometry in the periphery and in substoichiometric form in the core. The pressures observed for barium and zirconium are attributable to the presence of barium zirconate and uranate in the solid. The results obtained on a metal globule prove that it is formed in the course of the irradiation process by an evaporation-condensation phenomenon. (auth)

32282 (BARC-754) POST-IRRADIATION THERMAL RELEASE OF ^{133}Xe FROM SINTERED (ThO_2-0.1% $^{233}UO_2$) PELLETS. Naik, M. C.; Kaimal, K. N. G.; Karkhanavala, M. D. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.). 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

Post-irradiation thermal release behaviour of Xe-133 from sintered ThO_2-0.1% $^{233}UO_2$ pellets has been studied and compared with that from ThO_2-0.1% $^{235}UO_2$ pellets. The investigation has been extended to analyse the release behaviour of Xe-133 as a function of sintered density. The initial burst release "fo" and apparent diffusivity "D" of Xe-133 from ThO_2-0.1% $^{233}UO_2$ are found to be of the same order as that from ThO_2-0.1% $^{235}UO_2$ pellet within experimental limit. It has been observed that fo and D decrease slowly as the sintered density increases by 18% from 67 to 85% and then decreases very sharply as the density increases by 6% from 85 to 91%. The results have been explained on the basis of abnormal increase of closed porosity and sharp decrease in open porosity in case of high density sintered pellets. 6 references. (auth)

32283 (CEA-R-4649) REDISTRIBUTION DURING IRRADIATION OF THE CONSTITUENTS AND FISSION PRODUCTS IN AN URANIUM-PLUTONIUM MIXED-OXIDE FUEL. Sauvage, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Jan 1975. 123p. (In French). Dep. NTIS (U. S. Sales Only) $9.25.

Thesis. Submitted to Paris Univ., Orsay, France.

Vapor-pressure measurements were made by the Knudsen effusion technique on uranium-plutonium mixed oxide and 316 SS clad samples irradiated in a fast breeder reactor. Assuming the existence of cesium molybdate phase, the oxygen-potential could be calculated at the fuel-cladding interface and for the center of the oxide. Molybdenum is considered to act as a buffer thus transporting oxygen and iodine towards the surface. Microprobe analysis and vapor-pressure measurements on a "metallic ingot," attached to the wall of the central void, are found to be in agreement with these assumptions. (auth)

32284 SPACING GRID FOR FUEL RODS. (to Societe Belge pour l'Industrie Nucleaire). Netherlands Patent 7,116,979. 10 Dec 1971. 7p. (In Dutch).

The invention provides a spacing grid for fuel rods within a fuel element for fast reactors. (NL)

32285 SPACER COMPOSED OF METAL STRIPS WITH FINS. (to Stichting Reactor Centrum Nederland). Netherlands Patent 7,116,242. 26 Nov 1971. 5p. (In Dutch).

The invention provides a fuel element grid consisting of parallel strips with connected fastening clips between them. (NL)

32286 CLOSURE OF FUEL CANS. (to Societe Belge pour l'Industrie Nucleaire). Netherlands Patent 7,205,217. 18 Apr 1972. 7p. (In Dutch).

The invention provides both an improved plug and a better welding process to seal off fuel rod cannings. (NL)

32287 NUCLEAR POISON. (to Centre d'Etude de l'Energie Nucleaire). Netherlands Patent 7,206,360. 10 May 1972. 5p. (In Dutch).

The invention provides a burnable poison for thermal nuclear reactors. The poison dysprosiumaluminate ($3\ Dy_2\ V_3\ 5\ Al_2\ 0_3$) is added as particles to the fuel during the fabrication process. (NL)

32288 SPACER FOR FUEL ELEMENTS THAT INFLUENCES CIRCULATION PATTERN OF COOLANT FLOW. (to Stichting Reactor Centrum Nederland). Netherlands Patent 7,207,098. 26 May 1972. 7p. (In Dutch).

The invention provides a grid for supporting fuel elements which take part in heat-exchange processes. It is possible to influence the circulation pattern of the coolant with this grid. (NL)

32289 GRID FOR SUPPORTING FUEL ELEMENTS. (to Stichting Reactor Centrum Nederland). Netherlands Patent 7,207,937. 12 Jun 1972. 8p. (In Dutch).

The invention provides a grid for supporting fuel elements which take part in heat-exchange processes. The partitions are provided with fastening clips which rest against a wall on at least one side. The fastening clips are stuck in the brace through openings. (NL)

32290 RADIATIVE AND CONVECTIVE HEAT TRANSFER FROM TRANSVERSE FINNED FUEL RODS. Michiyoshi, I.; Takahashi, O.; Yamaguchi, K. 74-WA/HT-6. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

One plain rod and 28 transverse-finned rods were tested in an annulus. Correlations of both radiative and convective heat transfer and pressure drop, including factors to account for fin-height and fin-spacing, are presented. A theory of radiative heat transfer of transverse-finned rod in the annulus is also presented. 17 references. (auth)

32291 MEASUREMENT OF FUEL PIN DIMENSIONS BY QUANTITATIVE NEUTRON RADIOGRAPHY. Stora, J. P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie); Perves, J. P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Piles). Bull. Inform. Sci. Tech. (Paris); No. 196, 73-76(Oct 1974). (In French).

Precision neutrography was used for the quantitative study of in-pile uranium oxide pellet sintering. The apparatus used is described with its dysprosium indicators which give the neutrons an excellent image contrast and enable the shortening of a stack of pellets to be followed to within ±0.03mm at different stages of irradiation, the temperature distributions being evaluated at the same time. (FR)

32292 THE IRRADIATION EXPERIMENT DFR 409. Anselin, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Bull. Inform. Sci. Tech. (Paris); No. 196, 27-40(Oct 1974). (In French).

Several mixed oxide fuel pins with stainless steel cladding have been irradiated in the DFR reactor up to 13.7 at. % burnup and 1.05×10^{23} n/cm^2 (TREFOIL DFR 409). Reported are the dimensional changes of the pin (axial elongation, two peak diametral strain profile; anisotropy of distension (axial versus diametral) in relation with the two different steel swelling mechanisms by void formation and the two different irradiation creep mechanisms of the clad (one athermal, the other thermally activated); the fuel column/pin axial elongation mechanisms and the corresponding evolution of the fuel microstructure; the several type of damages observed on the inner face of the clad, either at the fuel column level or the UO_2 insulator pellets which act as a sink for some specific fission products (iodine and cesium); the end of life pin failure which occurred at one junction fuel column-insulator pellet in one pin and the consequences of the sodium penetration at very high burnup. (FR)

32293 FIRST EXPERIMENT OF IRRADIATION IN RAPSODIE OF CARBIDE ELEMENTS WITH SODIUM SEALS (CAMILLE EXPERIMENT). Mikailoff, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium); Clottes, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). Bull. Inform. Sci. Tech. (Paris); No. 196, 41-48(Oct 1974). (In French).

The results achieved with carbide type fuel elements irradiated in Rapsodie in 1969 and 1970, as a complete assembly of 19 pins, are presented. This assembly functioned at a maximum linear power of 800W/cm, a 660°C cladding temperature and reached a specific burn-up of 27,000MWd/t. The results of the examinations made after irradiation gave a certain number of values, particularly the swelling of the fuels and the fission gas release rate. Despite slight carburization of the claddings and some anomalies in the functioning of the sodium seal giving rise to hot spots inside the fuels, the pins performed in a completely satisfactory manner; no deformed or burst claddings. Among the four materials tested (UPuC, UPu-C-Mo, UPu-CN and UPu-N), the UPu-C-Mo carbide alloy gave the least satisfactory performance under irradiation; there was no appreciable difference between the three other fuels. (FR)

32294 FUEL ELEMENTS FOR LIGHT-WATER REACTORS (LWR), HIGH-TEMPERATURE REACTORS (HTR), FAST SODIUM BREEDER (SNR) AND GAS-COOLED FAST BREEDERS (GSB). Progress Report from the Technical Committee "Fuel Elements" of the Nuclear Association in the German Atom Forum (KTG). Clauss, J. (Badenwerk A. G., Stuttgart (F. R. Germany). Projektarbeitsgemeinschaft Elektrizitaetsenergieversorgung Schwaben). At. Strom; 20: No. 11/12, 127-129(Nov 1974). (In German).

A short outline is presented of the lectures and discussions held at the Nov 1974 meeting of the KTG. The outline is given from the point of view of an electrical utility. (GE)

32295 A DEVICE FOR ADJUSTING THE POSITION OF A WELDING ELECTRODE. Dufayet, J. P.; Marti, A. (to CEA, 75-Paris (France)). French Patent 2,199,492. 15 Sep 1972. 10p. (In French).

Description is given of a device for adjusting the position of a welding-electrode, in particular in register with a gap between two parts to be welded. That device is characterized in that it comprises a welding electrode located in a plane containing a probe constituted by an electromagnetic coil adapted to generate eddy-currents in the peripheral zone of the parts to be welded, an electronic unit adapted to control and measure these currents in the form of a signal permanently compared with a pre-determined threshold level, so as to detect the passage of the probe in register with the gap between the two parts, and a motor for moving the electrode and probe in parallel relationship with the parts. This device can be applied to welding an end cap to the fuel pin clad. (FR)

32296 CARBIDE FUEL ELEMENT WITH HELIUM SEAL FOR FAST NEUTRON REACTORS. Problems Arising from Fuel Swelling. Mikailoff, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Bull. Inform. Sci. Tech. (Paris); No. 196, 49-54(Oct 1974). (In French).

The fissile columns consist of a stainless steel-clad stack of sintered pellets with helium as thermal joint between carbide and cladding. Experiments have shown that swelling increases strongly with temperature, and in spite of a reduced filling density inside the fuel element the cladding showed deformations in every test. A densification of the carbide was also observed due to fast sintering at the beginning of irradiation the rate increasing with the central temperature. This leads to over-heating of the carbide which means that the linear power must be limited to avoid melting of the fuel. These first results suggest that the development of a carbide fuel element will be difficult. (FR)

32297 THE NUCLEAR FUEL CYCLE. Quaassdorff, P. Energy. Tech.; 26: No. 10, 228-232(Oct 1974). (In German).

A presentation is given on the fuel cycle of nuclear power plants in its various processing stages from the extraction of uranium ore up to the preparation of the complete fuel elements at the reactor and the reprocessing of the spent, irradiated fuel elements including the recovery of still utilizable nuclear fuels. The methods used and the available capacities and their foreseeable completion are described, and a prognosis of the future market on the basis of expected additions of nuclear power plants is made. Finally, the assigning of the individual processing costs to the fuel cycle costs based on the known market prices today are given. (GE)

Reactor Control Systems

Refer also to abstracts 32194 and 32195.

32298 (GEAP-13824-11) LMFBR ALTERNATE SHUTDOWN SYSTEM AND CRITICAL COMPONENT DEVELOPMENT AND TESTING. Eleventh Quarterly Report, July–September 1974. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1974. Contract AT(04-3)-893. 20p. AT.

The design of the Alternate Shutdown System (ALSS) is described. Pertinent sections of the Preliminary Safety Analysis Report (PSAR) were prepared and submitted to Westinghouse. Drive mechanism and driveline design efforts were focused upon refinements in preparation for initiating detail drawings. The control assembly design focused upon the effect of an increased B^{10}/loading and the effect of a standard versus a modified inlet module. Component development testing continued and preparations were made for beginning new testing. The Critical Component Development Program (CCDP) was initiated. (auth)

32299 (GEAP-14030-1) CONTROL ASSEMBLY ENGINEERING FIRST QUARTERLY REPORT, AUGUST–OCTOBER 1974. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1974. Contract AT(04-3)-893. 8p. AT.

The development of reliable and economic advanced absorber assemblies for use in LMFBR core systems in accordance with LMFBR Program Plan 6-213-1 is described. Progress during August, September and October 1974 is described for subtasks related to FTR irradiation, interface activities with HEDL and ORNL and advanced absorber assembly design trade-off study. (5 references) (auth)

32300 (RN-DR-0180A) DESIGN REQUIREMENT SHEETS FOR THE INSTRUMENTATION-AND-CONTROL SUBSYSTEM, EC 90214. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 52p. Dep. NTIS $5.75.

Specification requirements for the Instrumentation and Controls Subsystem (EC-90214) of the 75K, Full Flow NERVA engine are presented. Drafts of several proposed changes are included in the notebook. (LTN)

32301 (RN-S-0450(Rev. 1)(Pt. 2)) HANDBOOK OF OPERATING AND MAINTENANCE FOR XE-1 ENGINE CONTROL SYSTEM. Part II, Revision 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 85p. Dep. NTIS $7.25.

The engine controller/programmer chassis, R49A2 and R49A5, provide the overall timing and sequencing functions necessary for the safe startup, ramping to rated power, mapping, and shutdown of the XE-1 engine. In addition, selected demand generators and the pressure controller subsystem are contained within these chassis. The chassis electronics with the exception of the electromechanical components associated with mode selection, indication, and logic, are entirely solid state. All active and passive components (except some relays) are mounted on glass epoxy, single-sided, printed circuit cards, vertically plug-in mounted in the front portion of the chassis. (auth)

32302 (RN-S-0450(Rev. 1)(Sect. 5)) HANDBOOK OF OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-1 ENGINE CONTROL SYSTEM. Revision 1, Section V. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1969. 7p. Dep. NTIS $4.00.

A few pages of section V have been revised. (LTN)

32303 (RN-TM-0176) ALTERNATE METHODS OF ENGINE CONTROL. Sheridan, E. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 16 Mar 1964. 7p. Dep. NTIS $4.00.

The control variables of interest for the nuclear rocket engine are temperature and pressure. These variables may be controlled in many ways: Independent loops-temperature and pressure demands generated from independent sources; pressure demand obtained from measured temperature; or temperature demand obtained from measured pressure. When the control loops are coupled by either of the latter methods, one variable becomes dependent on the other. The reasons for doing this and the advantages and disadvantages are discussed and the following conclusions drawn: The temperature and pressure systems are naturally coupled. The reasons for introducing external coupling are: to achieve independent control of temperature and pressure, to improve the system response characteristics, and to simplify equipment required for system programming. External coupling increases the complexity of the control system. Some advantages must be achieved to make coupling worthwhile. From a safety point of view the two methods are not significantly different. For stability and lack of sensitivity to component changes, method two (pressure demand obtained from measured temperatures) is much better than three. (auth)

32304 (TID/SNA-875) INTERIM TRADE STUDY REPORT. Poison Wire Removal and Insertion on Ground, October 1969 Through February 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1970. 37p. Dep. NTIS $5.00.

A number of poison wire withdrawal/reinsertion device concepts were reviewed and evaluated with respect to the feasibility of each concept to provide a means of removing and replacing poison wires. The poison wires are inserted into the reactor core to guard against accidental criticality of the NERVA Engine. In order to evaluate the poison wire concepts, a cursory functional flow diagram was prepared. The function of the wires during transportation, engine assembly, engine acceptance testing, stage assembly and checkout, and vehicle launch pad operations was then analyzed. Based on this study and Government recommendations, not one, but three poison wire withdrawal/reinsertion concepts were suggested to perform these functions. The assumptions and requirements upon which this decision was based are described herein. (auth)

32305 (TID/SNA-1074) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Instrumentation and Control System. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 66p. Dep. NTIS $6.50.

Detailed specifications (Revision B) are provided for the 75K, Full Flow NERVA engine as follows: Instrumentation and Control System (EC-90214B). (LTN)

32306 (WANL-TME-479) INDIVIDUAL DRUM POSITIONER FOR NRX TESTS. Norman, H. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Jun 1963. 11p. Dep. NTIS $4.00.

A device which will permit independent control of the position of each drum has been designed for use in certain NRX tests. Selected drums can be positioned or oscillated without regard to the control mode of the others. The device contains positioning potentiometers, switching to transfer any drum from normal gang control to individual control, and circuitry to insure that such a transfer does not cause an unacceptable transient. It is housed in a small cabinet which sits on the table of the CTO console, and plugs into receptacles on that console. For most tests, in which only gang control is required, the drum positioner is removed from the CTO console and it is replaced by a jumper cable underneath the table. (auth)

32307 CONTROL SYSTEM FOR A NUCLEAR POWER INSTALLATION, PARTICULARLY SUITED TO A SODIUM-COOLED FAST REACTOR. (to Neratoom NV). Netherlands Patent 7,204,745. 10 Apr 1972. 13p. (In Dutch).

The invention provides a control system for a sodium-cooled fast reactor. The installation supplies heat to a steam generator. The installation encloses at least two cycles for the transport of heat. These cycles are hydraulically separated from each other but connected by heat exchangers. The water-steam cycle is provided with a feedwater pump and a steam turbine. The reactor circuit is provided with a primary circulating pump, filled with a heat exchanging medium (different from water). The heat exchangers show a relatively small pressure drop when working. A third heat-exchange cycle is inserted. (NL)

32308 EFFECT OF VARIOUS CONTROL MODES ON THE STEADY-STATE FULL AND PART LOAD PERFORMANCE OF A DIRECT-CYCLE NUCLEAR GAS TURBINE POWER PLANT. Covert, R. E.; Krase, J. M.; Morse, D. C. 74-WA/GT-7. New York; American Society of Mechanical Engineers (1974). 9p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The performance and principal operating characteristics of the Gas Turbine HTGR power plant are reported. The reference design of the dry cooled 1100-MW(e) power plant incorporates four helium gas turbine power conversion loops integrated into the prestressed concrete reactor vessel, which also contains the reactor and the entire primary coolant system. The reactor core is virtually the same as that for the comparable HTGR steam cycle and is operated with similar maximum fuel temperatures, resulting in a turbine inlet temperature of 1500 F (816 C). An overall plant efficiency of about 37 percent is realized with a design point cycle pressure ratio of 2.35 and with a high-effectiveness recuperator in each loop. Component performance and cycle performance calculations are discussed. The variation of plant performance with ambient temperature is described. Three distinct control modes are described which are, in order of decreasing part-load efficiency, helium inventory control, reactor outlet temperature control, and bypass flow (compressor outlet to turbine outlet) control. The latter offers the most rapid control of plant output. Also described is the standard operating control mode which combines reactor outlet temperature and bypass controls to facilitate both ramp and step load changes. 7 references. (auth)

32309 LINEAR AND LOGARITHMIC NEUTRON MEASUREMENT SUBASSEMBLY FOR DIRECT CURRENT. Vaux, C.

(CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 19-20(Sep 1974). (In French).

Direct current period meters and linear measurement lines are normally used for nuclear reactor control at the intermediate and power levels. The SPALISB 13 type linear and logarithmic line fulfils both these functions simultaneously (Multibloc). The logarithmic measurement ranges from 10^{-11} A to 10^{-3} A and the linear measurement from 10^{-6} A to 10^{-3} A, in 4 calibers, with a gain variable from 1 to 10. The doubling time measurement scale is -3s to +3s. (FR)

32310 A DEVICE FOR ENGAGING AND DISENGAGING THE RACK AND PINION IN THE DRIVING MECHANISM OF A NUCLEAR REACTOR REGULATING MEANS. Maslenok, B. A.; Zlobin, V. G.; Khegai, A. S.; Nikolaev, V. P.; Krjuger, E. A. French Patent 2,180,493/A/. 18 Apr 1972. 6p. (In French).

32311 A LIQUID ABSORBER SAFETY-ROD FOR NUCLEAR REACTORS. Malaval, C. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). French Patent 2,188,245/A/. 2 Jun 1972. 9p. (In French).

This safety rod comprises a reservoir or tank, the upper-compartment of which is filled with liquid absorber and is connected to a lower compartment located within the reactor core, filled with pressurized gas by means of a disconnectable hollow rod. Regulation of the gas pressure within the lower compartment causes the amount of absorber falling into that compartment to vary. Once the hollow rod has been disconnected all the liquid absorber falls into the lower compartment. This safety rod can be used both as a regulating rod and for controlling the safety of nuclear reactors. (FR)

32312 A SOLID-ABSORBER SAFETY-DEVICE FOR NUCLEAR REACTORS. Malaval, C. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). French Patent 2,188,248/A/. 2 Jun 1972. 10p. (In French).

The description relates to a safety device for nuclear reactors, containing a solid absorber in compact or powdered form, stored just above the reactor core in a reservoir, or tank, the lower portion of which is located within the core. This reservoir is filled with pressurized gas and is provided with a closing member (e.g. a diaphragm or a uranium pellet). In case of faulty operation of the reactor, this closing member is destroyed, whereupon the reservoir lower portion is depressurized, so that the gas surmounting the absorbent expands and causes the latter to fall. This safety device is used as a fuse in nuclear reactors and in particular, in sodium cooled fast reactors and in gas cooled reactors. (FR)

32313 A LIQUID-ABSORBER SAFETY-DEVICE FOR NUCLEAR REACTORS. Malaval, C.; Picou, J. L. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). French Patent 2,188,247/A/. 2 Jun 1972. 7p. (In French).

The description relates to a liquid-absorber safety-device for nuclear reactors constituted by a cylindrical reservoir, or tank, comprising two communicating superimposed compartments. The upper compartment, located above the reactor core, is filled with liquid absorbent surmounted with pressurized gas. The lower compartment, located within the core, is filled with pressurized gas and is provided with a duct in communication with the outside, the extremity of the duct comprising a closing member which is responsive to the reactor operating conditions. In case of faulty operation, this closing member is destroyed, whereupon the lower compartment is depressurized and the absorbent falls into the latter. This device can be applied to any nuclear reactor, and in particular, to gas cooled reactors and to sodium cooled fast reactors. (FR)

32314 A POSITION SENSOR WITHOUT MECHANICAL CONTACTS. Pelenc, Y.; Ambier, J.; Lavergne, R. (to Etablissements Merlin et Gerin, 38-Grenoble (France)). French Patent 2,182,400/F/. 25 Apr 1972. 12p. (In French).

This device makes use of the variable magnetic coupling between a primary winding and oppositely connected secondary windings. The arrangement and interconnection of the secondary windings are so chosen as to deliver a coded digital information, the treatment of which is specially easy. The sensor according to the invention can be used for sensing the position of the control-rods of a nuclear reactor. (FR)

32315 A POWDERED-ABSORBER SAFETY-ROD FOR NUCLEAR REACTORS. Malaval, C. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). French Patent 2,188,246/A/. 2 Jun 1972. 11p. (In French).

This safety rod comprises a reservoir, or tank, with three superimposed compartments, a lower compartment located within the reactor core and filled with pressurized gas by means of a disconnectable hollow rod, an intermediate compartment located just above the core, the compartment containing the absorber and communicating with the lower compartment, and an upper compartment located within the reactor and communicating with the intermediate compartment. Once the hollow rod has been disconnected, all the powdered absorber falls into the lower compartment. This safety rod can be used for controlling the safety of reactors. (FR)

32316 REACTIVITY METERS FOR THE MEASUREMENT, CONTROL AND SAFETY OF REACTORS. Plaige, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 25-28(Sep 1974). (In French).

The reactivity of a reactor is an important parameter for both physicists and operating staff. As a measurement apparatus it is widely used for control rod efficiency, reactor poisoning measurement and estimation of void or temperature coefficient. It has also been used as a safety instrument in the power range since it is the fastest and most sensitive one. It is now being considered to use this apparatus as a control and safety means in the subcritical and intermediate range. (FR)

32317 USE OF DIGITAL ICTOMETERS IN CONJUNCTION WITH MULTIBLOC LINES FOR NEUTRONIC MEASUREMENTS (CONCAL SYSTEM). Gauthier, G.; Hedde, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 29-35(Sep 1974). (In French).

CONCAL is a data acquisition and treatment system equipped with standard material and a minicomputer designed to measure the power, period and reactivity of a nuclear reactor over the whole working range. This system has been in operation for a year on the reactor ULYSSE. (FR)

32318 TECHNICAL ASSISTANCE FOR THE INSTALLATION AND STARTING UP OF CONTROL EQUIPMENT. Garau, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 45-47(Sep 1974). (In French).

An efficient technical assistance for the installation and starting up of reactor safety and control equipment relies on a well-established test procedure, improvization being reserved for special cases. (FR)

32319 TEST GENERATORS FOR A MEASUREMENT SYSTEM. Vaux, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Bull. Inform. Sci. Tech. (Paris); No. 195, 37-39(Sep 1974). (In French).

These instruments are designed to check the functioning subassemblies used for reactor control. A weak current generator and a test generator for period meters are being developed. (FR)

32320 A HYDRAULIC CONTROL AND SAFETY DEVICE FOR SODIUM-COOLED FAST REACTORS. Malaval, C. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). French Patent 2,191,212/A/. 28 Jun 1972. 9p. (In French).

The description relates to a hydraulic control and safety device for fast reactors, in which the displacements of the absorbing elements within the reactor body are obtained through a differential pressure of the cooling liquid on the two faces of a piston of absorbent material. According to another embodiment, the differential pressure is achieved by means of an electromagnetic pump immersed in the cooling liquid, the latter being, for instance, liquid sodium. (FR)

32321 CONTROL AND SAFETY DEVICE FOR FAST REACTORS. Delemontey, R. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). French Patent 2,191,213/A/. 29 Jun 1972. 12p. (In French).

A control and safety device for fast reactors, comprising a resilient connecting member and a coupling device located within the reactor, under the top shield is described. The coupling device is still reliable at high temperatures and it is located in close proximity to the absorbent element. The resilient connecting member ensures a perfectly safe operation, even in the case of a marked misalignment between the mechanism and the control rod. Application is made to fast reactors, the cooling fluid of which is liquid sodium. (FR)

32322 A DRIVE MECHANISM FOR NUCLEAR REACTOR CONTROL RODS. Marmonier, P.; Naudet, R. (to CEA, 75-Paris (France)). French Patent 2,189,816/A/. 20 Jun 1972. 21p. (In French).

The description relates to a device for controlling the position of a nuclear reactor control rod. The control rod comprises a

body adapted to slide in a sleeve and extended by an axial pin, the extremity of which has a head adapted to be gripped by a hook mounted on a transfer tube. This control rod is characterized in that it comprises a guide tube surrounding the transfer tube of a diameter substantially equal to that of the sleeve and adapted to cap the upper end of the latter, and a mechanism for controlling the translation of the guide tube in such a manner; thus it permits the latter to move axially in view of the differential expansion between the sleeve and the main vessel containing the reactor. This control rod can be used in fast neutron reactors. (FR)

32323 FAST-RESPONSE NEUTRON MEASUREMENT UNIT. Impulse-Fluctuation Combination. Plaige, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique); Mai Vuong, V. Q. (Etablissements Merlin et Gerin, 38-Grenoble (France)). Bull. Inform. Sci. Tech. (Paris); No. 195, 21-24(Sep 1974). (In French).

By maximum utilization of the data supplied by a fission chamber it is possible to extend the response of the measurement system and reduce the number of detectors necessary for reactor control. This is useful both economically and from the safety viewpoint since the same detector serves at reactor shutdown and at full power, hence permanently. A response of 10^{10} is obtained by using impulse measurements at low power and fluctuation measurements for count rates equivalent to or higher than 5.10^5c/s. The reactor is supervised at nominal power by current linear measurements obtained from the same detector (from 1% to 150% P_N. This instrument supplies a single logarithmic item of information and a single period in the whole measurement range of the apparatus. (FR)

Nuclear Power Plant Economics

Refer also to abstracts 31862, 31863, and 32343.

32324 COLLOQUIUM ON ENERGY, DECEMBER 5-7, 1973. Round Table on the Possibilities of Nuclear Power. Bull. Inform. A. T. E. N. (Ass. Tech. Energ. Nucl.); No. 106, 5-18(Mar 1974). (In French).

The possibilities of nuclear power, which will have supplanted petroleum in the next 25 years for electricity production, are discussed. Nuclear power is also expected to partially replace petroleum as a heat source and an energy source for the production of new fuels. Public organizations will have to accelerate research in reactor development, especially breeder reactors. Prospecting for uranium, radioactive waste storage, and the development of new fuels must be emphasized. (FR)

32325 DEVELOPMENT AND TECHNICAL OPERATING EFFICIENCY ANALYSIS OF THE NON-AVAILABILITY OF THE RWE POWER STATIONS. Fehndrich, W.; Hlubek, W.; Kutsch, W. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F. R. Germany)). VGB Kraftwerkstechnik; 54: No. 11, 760-769(Nov 1974). (In German).

The determination of costs, availabilities and accidents are of considerable help in the decision of building, operation and maintenance of nuclear power plants. The technical operating efficiency analysis of the nonavailability in the RWE is under continuous further development; state and outlook are also reported. (GE)

32326 DEVELOPMENT TRENDS OF HEAT AND POWER GENERATION. Jurisch, J. Energie; 26: No. 10, 291-296(Oct 1974). (In German).

A survey is given on the primary energy carriers and their contribution to the energy supply. Based on this, a look at the future role of nuclear energy is given. (GE)

32327 THE ELECTRICITY AS VEHICLE OF NUCLEAR ENERGY. Neuve-Eglise, M. (Electricite de France, 75-Paris). Rev. Met. (Paris); 71: No. 7, 605-607(Jul 1974). (In French).

The costs per kWh delivered by thermal stations running on fuel oil and on nuclear energy are compared. Their development since the oil crisis is reviewed and the programmes contemplated to increase the production of nuclear electricity are presented (light-water and breeder reactor programmes). (FR)

32328 ENERGY PROSPECTS TO 1985. OECD Assessment of Long-Term Energy Development and Related Policies. Nucl. Eng. Int.; 20: No. 225, 119-121(Feb 1975).

A review is presented of a report which constitutes the first attempt by the OECD at a comprehensive assessment of energy problems in the OECD area for the period 1972 to 1985, and their implications for the economy as a whole. It presents possible effects on the energy market due to different price developments together with their implications, an assessment of member countries' degree of flexibility and the likely policies that may be followed and possibilities of international co-operation. Given severe energy and economic constraints this assessment evolves best possible development alternatives. (auth)

32329 DEVELOPMENTS IN POWER REACTOR ENGINEERING FOR THE ENERGY SUPPLY BY NUCLEAR FISSION ENERGY. Pruschek, R. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany). Hauptabteilung Entwicklung und Analysen); Breyer, W. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany). Stabstelle Anlagenkonzepte und Wirtschaftlichkeit). Energie; 26: No. 10, 365-377(Oct 1974). (In German).

A review is given on the reactor development projects carried out by the firm INTERATOM which is to be considered in connection with the possibilities for a permanent solution to the energy supply problem. (GE)

32330 THE PUBLIC ELECTRICITY SUPPLY IN HUNGARY. Peer, V. A. Energiewirt. Tagesfragen; 24: No. 11, 564-565(Nov 1974). (In German).

A report is given on energy consumption and power production in Hungary from 1925 to 1973. Plans to expand the power economy include building a first nuclear power plant at Paks on the Danube. (GE)

32331 PLANNING OF NUCLEAR POWER PROGRAMS WITH CONSIDERATIONS TO LOCAL ENERGY NEEDS AND MATERIALS RESOURCES AS APPLIED TO EGYPT. Fouad, H. Y. (Atomic Energy Commission, Cairo). Ann. Nucl. Sci. Eng.; 1: No. 7/8, 459-462(Jul 1974).

An example for a possible nuclear power program is outlined and its dependence upon estimated power requirements and materials availability is illustrated. The importance is stressed of an early start on plans for materials production and power reactors in order that local resources may be utilized and the most promising fuel cycle adopted. (UK)

Reactor Fuel Cycle Economics

32332 ONE-WAY PEBBLE-BED REACTOR AS HIGH CONVERTER IN THORIUM CYCLE. Maly, V.; Schulten, R.; Teuchert, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 12, 601-603(Dec 1974). (In German).

The calculations for five reactor layouts are described; they are all fed with uranium-233 and thorium, but they differ in the quantity of the input breeder material and in its burnup. The influence of lay-out parameters such as use of U-233, high neutron absorption in the breeder material, low parasitic absorption, low neutron leakage and low neutron capture in the transition nuclides Pa-233 and Np-239 on the conversion ratio and on the fuel cycle costs is compared. (auth)

32333 OPTIMAL BRINGING OF REACTOR INTO THE STATIONARY REGIME OF FUEL RELOADING. Kochurov, B. P. Sov. At. Energy (Engl. Transl.); 37: No. 1, 747-750(Jul 1974).

Translated from At. Energ.; 37: No. 1, 66-68(Jul 1974).

The operation of a reactor in the stationary regime with continuous reloading of fuel allows considerable increase (by a factor of $\frac{3}{2}$-2) of the burnup and a reduction of the consumption of uranium compared with the regime in which all the fuel is reloaded at the same time. There is interest in investigating the transient regime of the reactor from the moment of its start-up to the output in the stationary regime. For a sufficiently large time interval, the strategy of reloading for which the minimum amount of fresh fuel is spent is analyzed. The principal requirements are that the solution be positive and that the reactivity of the reactor not be below a certain value. A constraint to be determined by the stability of the fuel elements is imposed on the burnup. The reactor is required to be found in a stationary regime from some fixed moment on. (6 references). (auth)

Reactor Licensing and Regulation

32334 (DOCKET-50155-363) BIG ROCK POINT NUCLEAR PLANT. 21 Semiannual Operating Report, July-December 1974. (Consumers Power Co., Jackson Mich. (USA)). 28 Feb 1975. 81p. Dep. NTIS $7.25.

The 12th refueling outage ended on July 27, 1974. Cycle 13 produced 228,796 MWH(e) gross through December 31, 1974. No plant outages occurred making 157 consecutive days of operation. Information is presented concerning operations, power generation, maintenance, changes, radioactive effluent releases, environmental monitoring, and occupational personnel radiation exposures. (FS)

32335 (DOCKET-50277-368) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Semiannual Operating Re-

port, July–December 1974. (Philadelphia Electric Co., Pa. (USA)). 28 Feb 1975. 64p. (DOCKET-50278-275). Dep. NTIS $6.25.

The first week in July marked the commercial operation of Unit 2 and the receipt of the fuel loading license for Unit 3. July 12 was the end of the warranty run on Unit 2. Throughout July, Unit 2 basically operated at full power while Unit 3 loaded fuel. During August, Unit 2 operated near full power most of the time, while Unit 3 progressed from the end of fuel loading to the initial generator energization. On September 1, Unit 3 generator was initially synchronized to the system and by month's end had completed the major 25 percent power dynamic tests. Unit 2 operated at full power until September 16, when load became limited to 900 MW(e) due to the loss of a condensate pump. All Unit 2 condensate pumps were operational by October 7, and load was no longer limited. October saw several outages on both Units 2 and 3. By month's end, Unit 3 had reached 850 MW(e). Unit 2 condenser tube leaks caused power reductions in the months of July, August, October, November and December. Modifications to the steam side of the condenser to reduce vibration of tubes in the effected zone corrected this problem. Both units experienced shutdowns in November and by month's end, Unit 3 had achieved nominal full power. Unit 3 was declared commercial on December 23 and all major transient testing had been completed. On the last day of the year, station output was in excess of 2050 MW(e). Information is presented concerning operations, equipment, maintenance, radioactive waste, personnel exposures, and administration. (FS)

32336 (DOCKET-50289-369) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Semiannual Operating Report, July–December 1974. (Metropolitan Edison Co., Reading, Pa. (USA)). 1 Mar 1975. 55p. Dep. NTIS $5.75.

Information is presented concerning operations, power generation, shutdowns, maintenance, radioactive effluent release, solid wastes, primary coolant chemistry, and personnel radiation exposures. Power escalation testing continued in July, but was discontinued from July 21 to July 24, then continued to August 13 when testing was completed. Commercial operation started on September 2 and the unit operated at power until October 20 when the unit was shutdown to perform pressurizer relief valve maintenance. The unit operated at power in November and December except for power reductions to stop condenser leaks, and solve feedwater conductivity problems. There was one shutdown to repair a faulty control rod drive motor. (FS)

32337 (DOCKET-50295-437) ZION NUCLEAR PLANT, UNITS 1 AND 2. Semiannual Operating Report, July–December 1974. (Commonwealth Edison Co., Chicago, Ill. (USA)). 1974. 110p. (DOCKET-50304-338). Dep. NTIS $8.50.

During this period, Unit 1 continued its start-up and power ascension program. Maximum power of 85% was reached July 23, 1974. During power operation, required flux mapping surveillance showed that power distribution was normal and hot channel factors are within specification limits. The Axial Power Distribution Monitoring System (APDMS) was installed and is being tested. Unit 2 was shutdown for repair of the generator until August 20, 1974. During the remainder of the period reactor start-up and the power ascension program continued until the reactor reached the present licensing power level of 85% on 11/8/75. Flux mapping surveillance showed normal power distribution and hot channel factors within specification limits. In December, the secondary coolant system was converted to all volatile treatment. The APDMS was installed and is being tested. Information is presented concerning operation and maintenance, plant personnel, and reports required by environmental and radiological specifications. (FS)

32338 (DOCKET-50309-298) MAINE YANKEE ATOMIC POWER PLANT. Semiannual Operating Report, July–December 1974. (Maine Yankee Atomic Power Co., Westboro, Mass. (USA)). 26 Feb 1975. 61p. Dep. NTIS $6.25.

The reactor was shutdown on June 29 and did not operate at power until October 11, 1974. During this time leaking fuel assemblies were replaced. Net electric power generated was 1,102,810 MWh, plant availability was 97.0%, and the reactor was critical for 744 hours. Summaries are presented concerning operations, power generation, shutdowns, maintenance, primary coolant chemistry, occupational personnel radiation exposure, release of radioactive materials, and abnormal occurrences. (FS)

32339 (DOCKET-50313-278) ARKANSAS NUCLEAR ONE, UNIT 1. Semiannual Operating Report, August–December 1974. (Arkansas Power and Light Co., Little Rock (USA)). 1 Mar 1975. 106p. Dep. NTIS $8.50.

Reactor operation for the period August 1974 (initial criticality) through December 1974 is discussed. Net electric power generated was 572,362 MWH. Information is presented concerning safety and non-safety changes in plant design and procedures, equipment and fuel performance, specification and FSAR changes, surveillance tests, reactor shutdowns, and maintenance. (FS)

32340 (DOCKET-50333-285) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Semiannual Operating Report, July–December 1975. (Power Authority of the State of New York (USA)). 28 Feb 1975. 50p. Dep. NTIS $5.50.

The reactor was licensed for operation on October 17, 1974. Fuel loading began November 1, 1974 and was completed November 17, 1974. Start-up and testing started. Information is presented concerning operations, maintenance, modifications, radiochemistry, radiation protection, fuel loading, abnormal operations, and waste disposal. (FS)

32341 (NP–20342) TOPICAL REPORT UEC-TR-001-1: QUALITY ASSURANCE PROGRAM. (United Engineers and Constructors, Inc., Philadelphia, Pa. (USA)). 11 Mar 1975. 78p. United Engineers and Constructors, Philadelphia, PA.

United Engineers & Constructors Inc. (UE&C) have established and implemented a Quality Assurance Program to provide assurance that the design and construction (including installation and pre-operational testing–but not operation) of nuclear power plants, performed by UE&C, are in conformance with applicable regulatory requirements and with the design bases specified in the license application. The Quality Assurance Program described is in compliance with the requirements of Appendix B to 10CFR Part 50. This report addresses and is responsive to the United States Nuclear Regulatory Commission Regulatory Guide 1.70.6, dated July 1974, which describes additional information required in the Quality Assurance Section of the Preliminary Safety Analysis Report for Nuclear Power Plants. (auth)

32342 NUCLEAR POWER PLANT SAFETY CRITERIA. Approved by the Laender Committee for Nuclear Energy. Cologne; Technischen Ueberwachungs-Vereine e. V. (1974). 22p. DM 5.-.

32343 LAW OF 9 JANUARY 1974 FOR THE ASSESSMENT OF ESTIMATES OF REVENUE FROM THE FUND FOR DEVELOPMENT OF A FAST BREEDER REACTOR FOR THE FISCAL YEAR 1974. (Ministerie van Economische Zaken, The Hauge). Staatsbl. K. Nederl.; 20: 1(Jan 1974). (In Dutch).

An estimate of the income and cost for the fiscal year 1974 from the Fund for the development of the SNR reactor is given. (NL)

32344 NOTIFICATION CONCERNING THE SHIFT OF COMPETENCE FOR THE KERNTECHNISCHE AUSSCHUSS TO THE FEDERAL MINISTRY OF THE INTERIOR. IRS Kurz-Inform., Reihe C; No. 19, 2-3(Sep 1974). (In German).

The tasks, the organizational structure, and the rules of procedure of the Kerntechnische Ausschuss of the FRG are briefly stated. (GE)

32345 NUCLEAR FACILITIES: EMERGENCY POWER SUPPLY. System-Tied Requirements; Generating Stations with Diesel-Engines. Draft. pp DIN-25417 B1.5 of German Norms. Berlin, F. R. Germany; Beuth (Jul 1974). (In German).

This draft standard deals with the specifications underlying the design, calculation, layout, construction and functioning of the emergency power supply in nuclear facilities, implying adherence to the relevant VDE specifications and the accident preventing regulations. Existing national and international relevant standards or similar publications have been taken into account. (GE)

32346 10th ANNIVERSARY OF THE FOUNDATION OF IRS. 10 Jahre IRS. Koeln, F. R. Germany; IRS (1974). 48p. (In German).

A comprehensive survey of the tasks and activities of the IRS (Institute for Reactor Safety) since its foundation within the framework of the atomic licensing procedure is presented. (GE)

32347 SUPPLEMENTARY QUALITY ASSURANCE REQUIREMENTS FOR INSTALLATION, INSPECTION, AND TESTING OF STRUCTURAL CONCRETE AND STRUCTURAL STEEL DURING THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. New York; American Society of Mechanical Engineers (1974). 20p. (ANSI-N-45.2.5-1974).

This standard sets forth the supplementary quality assurance requirements for installation, inspection, and testing of structural concrete and structural steel for nuclear power plant construction. Included are the following: formwork; steel reinforcement; embedded items; foundation preparation; concrete; and structural steel. The requirements may also be extended to other appropriate parts of nuclear power plants when specified in contract documents. This standard is intended to be used in conjunction with ANSI N45.2. (auth)

32348 NUCLEAR REACTOR SAFETY. Part 2, Volume II. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session, January 22, 23, 24, and 28, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 686p. GPO $5.55.

32349 NUCLEAR REACTOR SAFETY. Part 2, Volume I. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session, January 22, 23, 24, and 28, 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 556p. GPO $4.60.

GENERAL AND MISCELLANEOUS

Civilian Defense

32350 (AD-772688) CIVIL DEFENSE: ITS ROLE IN NUCLEAR DETERRENCE. Leonard, R. E. (Army War Coll., Carlisle Barracks, Pa. (USA)). 22 Feb 1971. 47p. NTIS $5.50.

The subject is discussed under the following sections: civil defense in historical perspective; civil defense in nuclear targeting strategies; and civil defense and arms control. (GRA)

32351 (AD-774235) CIVIL DEFENSE: FACT OR FANTASY. Lawless, D. R. (Army War Coll., Carlisle Barracks, Pa. (USA)). 19 Oct 1970. 21p. NTIS $4.25.

The essay examines the concept of survival in case of a nuclear war. Consideration was given to present United States policy, cost of civil defense, and slanting of building design to provide the maximum protection against radioactive fallout. A further study was undertaken to assess the number of casualties caused by a nuclear explosion on the core of a city. (GRA)

32352 (AD-774237) CIVIL DEFENSE AND ITS IMPORTANCE TO NATIONAL SECURITY. Liebmann, S. (Army War Coll., Carlisle Barracks, Pa. (USA)). 19 Oct 1970. 36p. NTIS $5.00.

The essay shows why it is vital to national security to have a civil defense program and goes on to analyze such programs. The US civil defense policy, similar to that of the Soviet Union, considers civil defense an integral part of the national defense effort. (GRA)

32353 (FSTC-HT-23-1082-70) PROTECTION OF CIVIL DEFENSE EQUIPMENT IN CONDITIONS OF A NUCLEAR WAR. Cherobokov, O. Nov 1973. Translation of Unidentified Russian Article. 8p. NTIS $3.00.

The document gives a response to the question on how to protect civil defense equipment in the condition of nuclear war. Various methods and types of equipment are used to solve the problems of civil defense in order to avoid massive losses of equipment and vehicles in a nuclear war. (auth)

Energy Utilization and Economics

32354 RESEARCH AND PROSPECTS ON THE PRODUCTION AND DISTRIBUTION OF HYDROGEN OBTAINED BY THE DISSOCIATION OF WATER USING NUCLEAR ENERGY. Luxo, A. (Gaz de France, 75-Paris). Rev. Met. (Paris); 71: No. 7, 581-585(Jul 1974). (In French).

The possibilities of dissociating water with recuperation oxygen by the direct use of heat generated by a high-temperature nuclear reactor are discussed. Certain problems such as hydrogen transport and storage, its industrial use alone or in combination with other fuels, are now solved. However a large-scale research effort is necessary for the industrial reactor development, the oxidation-reduction cycle and the system of communication for the transfer of fluids and thermal energy between the reactor and the chemical plant. (FR)

Information Handling

32355 (INDC-15/U) TECHNICAL MINUTES OF THE SIXTH INDC MEETING, VIENNA, 8-12 OCTOBER 1973. Joly, R. (comp.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Oct 1974. 130p. (CONF-7310104-). Dep. NTIS (U. S. Sales Only) $9.50.

These minutes contain information of a technical nature which was presented and discussed at the INDC meeting. They can be divided as follows: introductory items, committee business, short additions to progress reports which were submitted prior to meeting, reports of subcommittees, neutron data center activities, nuclear data requirements, targets and samples for nuclear data measurements, neutron data evaluation, nonneutron nuclear data, information sciences and policies, and meetings and conferences. (RWR)

32356 (ORNL-UR-122) STRUCTURING INFORMATION SYSTEMS FOR SOCIAL POLICY-MAKERS: AN ASSESSMENT. Tichenor, S. P. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 22p. Dep. NTIS $4.25.

The paper assesses the structure underpinning available information systems and concludes that the current classification schemes that are grounded in social science research are inadequate policy-making tools. Because social scientists and policy-makers have different information needs, decision-makers cannot expect social science methodologies and measures to be completely exportable to the policy-making arena. Concepts and methodologies developed by and for the academic disciplines do not provide the most appropriate measures for evaluating social science problems and effecting social change through government intervention. In light of this, policy-makers must establish their own needs and encourage the development of measures more amenable to decision-making. They can do this directly through their roles as data collection agencies and indirectly through their roles as research funding sources. Recommendations for restructuring the data collection and data use processes are offered in the conclusion of the paper. (auth)

Law

Refer also to abstracts 29580, 29629, and 29644.

32357 OCEAN POLLUTION. Hearings Before the Subcommittee on Oceans and Atmosphere of the Committee on Commerce, United States Senate, Ninety-Third Congress, First Session, June 12, 13, and 28, 1973. Washington, DC; Committee on Commerce (1974). 402p. GPO.

The June 12, 13, and 28, 1973 hearings before the U.S. Senate Subcommittee on Oceans and Atmosphere are reported verbatim. Sea pollution in general was discussed by numerous experts, and information pertinent to specific U. S. Senate bills was presented. Those bills were: S. 1067, to amend the oil pollution act, 1961 (75 stat. 402), as amended, to implement the 1969 and the 1971 amendments to the international convention for the prevention of the pollution of the sea by oil, 1954, as amended, and for other purposes; S. 1070, to implement the international convention relating to intervention on the high seas in cases of oil pollution casualties, 1969; and S. 1351, to amend the marine protection, research, and sanctuaries act of 1972, and for other purposes. (LCL)

32358 PROPOSED EXTENSION OF EXISTING RESEARCH AGREEMENT FOR COOPERATION BETWEEN THE UNITED STATES AND ISRAEL CONCERNING CIVIL USES OF ATOMIC ENERGY. Report by the Joint Committee on Atomic Energy, Senate, Ninety-Fourth Congress, First Session, February 13, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 10p. GPO.

The Joint Committee on Atomic Energy reported that after considering the proposed amendment to extend for two years the Agreement for Cooperation between the U. S. and Israel which has been in existence since 1955, the resolution should pass. The Agreement concerns peaceful research applications in the field of atomic energy, such as the use of radioisotopes for agriculture and medical purposes, reactor physics, and nuclear chemistry. The proposal was received on January 16, 1975 and the AEC was abolished on January 19, 1975 and the functions that relate to the proposed amendment were transferred to the Energy Research and Development Administration. Diplomatic notes and letters are published in the Appendix. (MCW)

32359 AEC WEAPONS PROGRAM AUTHORIZATION REQUEST, FISCAL YEAR 1975. Hearing Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session, February 20, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 19p. GPO $0.30.

Testimony on the fiscal year 1975 AEC authorization request relating to the Commission's nuclear weapons program was heard by the Joint Committee on Atomic Energy. The operating funds requested in the authorization amount to approximately $1.071 million including $875 million for operating expenses and $196 million for plant and capital equipment investment. Three major events that have affected the weapons program were listed: the SALT I atmosphere with the Soviet Union, an awareness of considerable activity by the Soviet Union in its strategic weapons research and development, and changes in the nuclear weapons related systems that will include the AEC's weapon research and development work. Commissioner W. E. Kriegsman discussed changes to the strategic doctrine and Dr. Richard Pipes, professor of history, Harvard University, discussed the Soviet position in the post-SALT I era. (MCW)

32360 PROPOSED INCREASE IN THE AMOUNT OF ENRICHED URANIUM WHICH MAY BE DISTRIBUTED TO THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA). Report by the Joint Committee on Atomic Energy, Ninety-Fourth Congress, First Session, February 13, 1975. Washington, DC; Joint Committee on Atomic Energy (1975). 6p. GPO.

On January 8, 1975, the U. S. Atomic Energy Commission

submitted to the Congress a proposal to increase the amount of enriched uranium that could be distributed by the U. S. to the IAEA. The proposal was referred to the Joint Committee on Atomic Energy. On January 19, 1975, the AEC was abolished and the Energy Research and Development Administration began a study on the proposal to increase the ceiling for uranium-235 for distribution to IAEA to allow for the support of the fuel cycle of power reactors, which will have a total installed capacity of 2,015 megawatts of electrical energy. Consideration of the action begins with the recognition that increasing the ceiling does not constitute a commitment of the U. S. to furnish the special nuclear material; the commitment will result from contracts for enriching services between ERDA and the purchaser of the services to the extent that enriching capacity is available. All of the enriched uranium that could be transferred would be subject to IAEA safeguards. The letter from the chairman of the Atomic Energy Commission requesting the increase is published in an Appendix. (MCW)

32361 PROPOSED INCREASE IN THE AMOUNT OF ENRICHED URANIUM WHICH MAY BE DISTRIBUTED TO THE EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM). Report by the Joint Committee on Atomic Energy, Senate, Ninety-Fourth Congress, First Session, February 13, 1975. Washington, DC; Joint Committee on Atomic Energy (1975). 8p. GPO.

On February 6, 1975, the Joint Committee's Subcommittee on Agreements for Cooperation held an open hearing on the proposal to increase the amount of enriched uranium that may be distributed to the EURATOM to support the fuel cycle of power reactors in the Community having electrical capacity to 55,000 megawatts from the current 35,000 megawatts. The AEC was abolished and the Energy Research and Development Administration began action on the proposal with the recognition that increasing the ceiling does not constitute a commitment of the U. S. to furnish the special nuclear material. The commitment to furnish such material would result from contracts for enriching services between ERDA and the purchaser of the services to the extent the enriching capacity is available. All special nuclear material that would be transferred to the Community would be subject to the Additional Agreement for Cooperation with EURATOM of 1960, as amended. The letter from the chairman of the Atomic Energy Commission requesting the increase is published in an Appendix. (MCW)

32362 REVISING AND AMENDING THE PRICE-ANDERSON INDEMNITY PROVISIONS OF THE ATOMIC ENERGY ACT OF 1954. Conference Report. House of Representatives, Ninety-Third Congress, Second Session, August 20, 1974. Washington, DC; Committee of Conference (1974). 6p. GPO.

The recommendations of the committee of conference on the disagreeing votes of the two Houses on the amendments of the Senate to the bill (H. R. 15323) to amend the Atomic Energy Act of 1954 are published. The Senate amended the bill by changing the definition of extraordinary nuclear occurrence to include incidents involving source, special nuclear material, or by-product material illegally diverted from its intended place of confinement. The House bill extended the definition of nuclear incidents to include occurrences outside the U. S. or any other nation involving material licensed by the AEC. The House bill provided for a 10-year extension of the Price-Anderson provisions of the Act to 1987. The House bill included language that prohibited any indemnification for nuclear incidents occurring in any nation other than the U. S. The House bill identified the study that must be completed before the bill's provisions go into effect as "The Reactor Safety Study, announced by the Atomic Energy Commission on June 27, 1973". (MCW)

Management

32363 (ANL/ES-41) METHODOLOGY TO MEASURE THE PERFORMANCE OF THE EPA REGIONAL EIS REVIEW PROCESS. Butz, B. P.; Senew, M. J. (Argonne National Lab., Ill. (USA)). Dec 1974. 64p. Dep. NTIS $6.25.

This study presents a methodology that will enable the Office of Federal Activities to assess the environmental impact statement (EIS) review process as performed at the regional level. Interviews with regional and OFA personnel as well as a perusal of the open literature form the basis of the methodology discussed. (auth)

32364 (BNL-50430) BROOKHAVEN HIGHLIGHTS, JULY 1972-JUNE 1974. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. Contract AT(30-1)-16. 105p. Dep. NTIS $5.45

A brief review of research performed at BNL from July 1, 1972 to June 30, 1974 is reported. The high-energy physics program centered on the Alternating Gradient Synchrotron. A design for an intersecting storage accelerator using superconducting magnets, named ISABELLE, was developed and brought to the stage of a production proposal. The nuclear physics program based on the Double Tandem Van de Graaff and the various research efforts at the High Flux Beam Reactor produced important results. Basic research in solid state physics, chemistry, and the life sciences is reported. New energy programs relating to socioeconomic studies of energy systems, the influence of the selection of offshore sites for power reactors, and construction of a demonstration section of superconducting transmission line are described. Personnel data are summarized and an effort toward energy conservation at the laboratory is described. (MCW)

32365 (GSF-A-47) SCIENTIFIC PUBLICATIONS AND REPORTS 1973. (Gesellschaft fuer Strahlen- und Umweltforschung m. b. H., Neuherberg/Muenchen (F. R. Germany)). Jul 1974. 30p. (In German). INIS.

In the present index, the printed publications appearing in the year 1973 as well as the internal reports which were published by the co-workers of the GSF or with their association, are compiled. The index includes the GSF report A 42 which contains the works of the year 1972. (GE)

32366 (NDS-7) THREATS OF MILITARY CONFLICT IN GEOLUNAR SPACE, 1975-1995. Heyman, D. F. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1968. 178p. Dep. NTIS $12.00.

Results of studies are reported on military applications of NERVA-type nuclear propulsion systems. Sociological, economic, geopolitical, and technological factors leading to military conflict in geo-lunar space are considered along with critical situations arising from tensions created by these environments. (JRD)

32367 (NTO-A-0022(Rev. 1)(Sec. I-4-1)) ORGANIZATION AND RESPONSIBILITIES OF THE NTO HEALTH AND SAFETY STAFF. Simens, H. G. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 May 1968. 16p. Dep. NTIS $4.00.

The policy and principles on which the organization, responsibilities, and authority of the Manager Nevada Test Office Health and Safety is based are described. Functions of organization are summarized along with program plans, and authority. (JRD)

32368 (RN-DR-0009) DEFENSE MARKET MEASURES (DM^2) OCTOBER, 1962-SEPTEMBER, 1963. (Aerojet-General Corp., Azusa, Calif. (USA)). [nd]. 16p. Dep. NTIS $4.00.

Listings of contract organizations associated with development of nucleonic propulsion systems are presented. Contract costs are listed along with information on development phase status, and project descriptions. (JRD)

32369 (RN-DR-0011) DEFENSE MARKET MEASURES: MISSILE NUCLEONIC PROPULSION SYSTEMS; MISSILE IONIC PROPULSION SYSTEMS. (Aerojet-General Corp., Azusa, Calif. (USA)). Mar 1964. 63p. Dep. NTIS $6.25.

A data collection, processing, and retrieval system designed to construct statistical measurements of the U. S. Defense Industry is presented. Through the application of data processing techniques to the analysis of contract award information, measurements are available of such indicators as dollar volume, market share, and product mix of the markets and companies that constitute the electronics and aerospace industries. These measurements are designed primarily for purchasing, market research, and corporate planning executives and analysts. They are a firm base of quantitative knowledge about the current market that give perspective to the massive new planning efforts that are evolving in defense industry companies. (auth)

32370 (RN-FOR-0027) NERVA PROGRAM. Operating Procedure, Area Coordinator's Handbook. Test Cell A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Sep 1963. 18p. Dep. NTIS $4.00.

Procedures used by the director of administration at the engine test site immediately before and during a test are outlined. Directions associated with communications, medical assistance, transportation, security, supply, emergencies, and safety are summarized. (JRD)

32371 (SAND-74-0074) SANDIA LABORATORIES TECHNICAL CAPABILITIES: PHYSICAL SCIENCES. Lundergan, C. D. (ed.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. AT(29-1)-789. 49p. Dep NTIS $5.50.

The activities that provide the basis for the physical sciences capabilities within Sandia Laboratories are characterized. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs. (auth)

32372 (TID/SNA-66) INDEPENDENT RESEARCH AND DEVELOPMENT PROGRAMS. Fiscal Year 1964 (1 December 1963-30 November 1964). Volume I. Program Descriptions.

(Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1963. 353p. Dep. NTIS $20.75.

Information on program expenditures, completion dates, and estimated effort in man-years is summarized. The programs are related to propulsion, power, chemistry, electro-optics, underwater technology, nuclear technology, physics, materials, aeronautics, explosives, life sciences, automation, communications and controls, and space systems. (JRD)

32373 (TID/SNA-132) NERVA TEST SUPPORT EQUIPMENT AND AEROSPACE GROUND EQUIPMENT PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 69p. Dep. NTIS $6.50.

The overall support system for the Nerva reactor is outlined in sections on system criteria, requirements, design and construction standards, and quality assurance. (JRD)

32374 (TID/SNA-442) NERVA CONFIGURATION MANAGEMENT PLAN, S018-SS090205-DF1, C-018. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1971. 46p. Dep. NTIS $5.50.

A plan is presented which establishes the philosophy for configuration identification, control, and accounting for the NERVA engine system, the nuclear subsystem, and the engineering critical components (ECC). This plan encompasses three objectives: (1) configuration identification, which is the positive identification of the specific design documents describing design requirements; (2) configuration control, which is the preparation and control of proposed changes to the established requirements or configuration and the implementation of the changes when approved; and (3) configuration accounting, which is the recording of the actual configuration of deliverable equipment. All descriptions of a system, or system equipment, used to state technical requirements are contained in formal specifications. These specifications delineate the design objectives which, in turn, establish the baselines for various phases of the program. (auth)

32375 LIFE IN A GOLDFISH BOWL. The Nuclear Industry and Public Disclosure. INFO 74 Conference on Nuclear Power and the Public, Kansas City, Missouri, March 3-6, 1974. Hosansky, E. A. (ed.). New York; Atomic Industrial Forum, Inc. (1974). vp. (CONF-740364-). $20.00.

"Nuclear Power and the Public" was the theme of the conference, attended by more than 200 utility, industry, and government public information specialists. The sessions are presented and deal with the unique public disclosure and public information requirements involving industrial uses of nuclear energy. The AEC, the utilities, and other nuclear related companies are modifying their information practices to meet the requirements of the laws and the needs of the public for complete, rapid, and up-to-date information. Because of the heightened public interest in the operation of nuclear power plants, the AEC plans to announce information, whether or not the utility did, about 13 kinds of events, including radiation release, employee injuries, environmental effects, and interruption of construction or operation. The problems and possible solutions of open disclosures were studied in case studies involving AEC and nuclear utilities that are trying innovative solutions and a panel discussion. (MCW)

Mathematics and Computers

Refer also to abstract 32068.

32376 (CONF-750406-1) AMERICAN NATIONAL STANDARDS INSTITUTE'S FORTRAN STANDARD: EFFECT UPON COMPUTER PROGRAM EXCHANGE. Marshall, N. H. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. 10p. Dep. NTIS $4.00.

From ANS topical meeting on computational methods in nuclear engineering; Charleston, South Carolina, USA (15 Apr 1975).

Most implementations of the Fortran computer language in use today are based upon two 1966 standards published by the American National Standards Institute. These standards have done much to minimize the problems of computer program portability, but they are no longer current. Fortran language needs have progressed beyond the 1966 standards. The American National Standards Institute's|X3J3 committee worked for several years to extend and update the 1966 standards. Their work should reestablish the value of the Fortran standard as a guide to the implementation and use of Fortran. The up-to-date guidelines provided by the proposed new Fortran standard should help minimize the problems of program interchange and program portability. Several of the extensions to Fortran included in the X3J3 proposed standard are discussed. Included are the addition of character data type, extensions to the DO loop, and extensions to Fortran input/output. (auth)

32377 (KIYAI-73-7) PRELIMINARY DATA PROCESSING IN THE FACILITY FOR MEASUREMENT OF SEVERAL STATISTICAL DISTRIBUTIONS. Berezin, F. N.; Kisurin, V. A.; Odinets, G. S.; Ofengenden, R. G. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1974. 15p. INIS.

The principles for data processing in the statistical multichannel analyzer are discussed. It is shown that data processing both at the time of acquisition and immediately after its acquisition is possible. (tr-auth)

32378 (ORNL-RSIC-38(Vol. 1)) TECHNIQUES FOR EFFICIENT MONTE CARLO SIMULATION. Volume 1. Selecting Probability Distributions. McGrath, E. J.; Basin, S. L.; Burton, R. W.; Irving, D. C.; Jaquette, S. C.; Ketler, W. R.; Smith, C. A. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 163p. Dep. NTIS $11.25.

Present techniques and methods for developing efficient Monte Carlo simulation for reducing computational effort is presented in three volumes: Vol. I - Selecting Probability Distributions; Vol. II - Random Number Generation for Selected Probability Distributions; and Vol. III - Variance Reduction. Volume I provides a straightforward approach and associated techniques for selecting the most appropriate probability distributions for use in Monte Carlo simulations. Part I, BASIC CONSIDERATIONS, presents the underlying concepts and principles for selecting probability distributions. Part II, SELECTION OF DISTRIBUTIONS, gives the mathematical models representing stochastic processes and presents step-by-step procedures for identification and selection of the appropriate probability distributions based upon the degree of knowledge and available data for the random variable under study. (auth)

32379 (ORNL-RSIC-38(Vol. 3)) TECHNIQUES FOR EFFICIENT MONTE CARLO SIMULATION. Volume III. Variance Reduction. McGrath, E. J.; Irving, D. C. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 161p. Dep. NTIS $11.25.

Many Monte Carlo simulation problems lend themselves readily to the application of variance reduction techniques. These techniques can result in great improvements in simulation efficiency. The document describes the basic concepts of variance reduction (Part I), and a methodology for application of variance reduction techniques is presented in Part II. Appendices include the basic analytical expressions for application of variance reduction schemes as well as an abstracted bibliography. The techniques considered here include importance sampling, Russian roulette and splitting, systematic sampling, stratified sampling, expected values, statistical estimation, correlated sampling, history reanalysis, control variates, antithetic variates, regression, sequential sampling, adjoint formulation, transformations, orthonormal and conditional Monte Carlo. Emphasis was placed on presentation of the material for application by the general user. This has been accomplished by presenting a step by step procedure for selection and application of the appropriate technique(s) for a given problem. (auth)

32380 (SAND-74-0417) USER'S MANUAL FOR THE SANDIA MICROCIRCUIT MASK GENERATION PROGRAM. Version II. Schroeder, D. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1974. Contract AT(29-1)-789. 37p. Dep. NTIS $5.00.

The Sandia Microcircuit Mask Generation Program is a software package oriented towards translating microcircuit design information into photographic masks. The program is applicable to most microelectronic technologies such as semiconductor device, integrated circuit, hybrid thin film, hybrid thick film, magnetic bubble, and microwave integrated circuits that use photolithographic fabrication processes. The design information is translated into photographic mask generation data by the CDC 6600 computer operating in the batch process mode, while outline drawings are generated by the Datagraphics SD 4020 output recorder; the finished artwork is produced on the Gerber plotter. Version II of this program offers increased capabilities and significant operating economies over the original version. (auth)

32381 (SAND-75-5052) A LATTICE ALGEBRA FOR FINDING SIMPLE PATHS AND CUTS IN A GRAPH. Hulme, B. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 12p. (CONF-750213-1). Dep. NTIS $4.00.

From 6th southeastern conference on combinatorics, graph theory and computing; Boca Raton, Florida, USA (17 Feb 1975).

An algorithm for finding simple paths in a directed or undirected graph has been given by Fratta and Montanari, and a similar algorithm for cuts has been presented by Martelli. Each of these authors has developed a different "regular algebra" appropriate for the problem. An algebra is presented, almost identical to Martelli's, in which both the simple path and cut algorithms are valid. It is shown that this algebra is a self-dual

distributive lattice. The treatment of the simple paths and cuts within a single algebraic structure are unified and they are naturally related by the concept of duality. (auth)

32382 (UCCND-CSD-INF-6) APPROXIMATE SIMULATION OF A LARGE COMPUTER SYSTEM. Burris, R. D. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. Contract W-7405-eng-26. 68p. Dep. NTIS $6.50.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

An attempt was made to develop and use a simulation model of a computer system. The model was designed to provide data about all types of processes affecting the elapsed time of a computer job, yet to do so with minimal resource consumption. To this end, similar portions of the processing were grouped whenever logically feasible, thereby much reducing model processing time without serious impact on the validity of the results. The data gathered for input, the logic of the model, the validation effort, and several of the uses to which the tool was applied are described. (auth)

32383 (UCRL-51691(Rev. 1)) NEAR FIELDS: INHERENT COMPUTATIONAL DIFFICULTIES IN MOMENT-METHOD FORMULATIONS. Adams, R. W.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Mar 1975. Contract W-7405-Eng-48. 64p. Dep. NTIS $5.45.

Tangential and radial near fields, linear charge densities, and current distributions are calculated with seven thin-wire modeling programs using varying basis and weight functions and numerical treatments. The test case geometry is a half-wave, 1-m linear dipole with $\Omega = 15$. Each program is explained briefly and compared with similar codes. The results are presented graphically, and some basic observations are made. (auth)

32384 (UCRL-51694) OCTAL DEBUGGING PROGRAM (ODT-80) FOR THE MCS-80 COMPUTER. Fisher, E. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Feb 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $4.00.

ODT-80 is an octal debugging routine for use on the Intel 8080 microprocessor. The routine provides the capability to examine and modify all the memory that is available to the microcomputer and transfer program control to the created program. ODT-80 makes use of simple keyboard commands from any terminal—such as a teletypewriter—that is attached to the system. (auth)

32385 (UCRL-76122) USING A STATISTICAL PROCEDURE TO FINE TUNE A COMPUTER OPERATING SYSTEM. Fallon, T Gluckman, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jan 1975. 10p. (CONF-750215-1). Dep. NTIS $4.00.

From 8th annual symposium on the interface; Los Angeles, California, USA (13 Feb 1975).

Fine tuning a computer operating system was done using Gumbel's asymptotic distribution of extreme values. Communication between the CDC 7600 and the storage units or terminal users is through an autonomous computer called the Peripheral Processor Unit (PPU). The communication protocol between the 7600 and the PPU requires the setting of several maximum waiting times. Usually this type of communication protocol is based on a handshake procedure and the waiting times tell each unit how long to wait before abandoning the proposed task and assuming another task. If the random variable Y is the maximum observed wait time for a period of time τ, then the distribution of Y can be approximated by $F(y) = \exp\{-\exp[-\alpha(y-\beta)]\}$, when the number of wait time values is large and the distribution of the wait times has exponential tails. The parameters α and β depend on the size of the period of time τ and the character of wait times. The paper shows that for the computers at LLL, the above distribution can be used to approximate the observed maximum wait times. The paper shows how this distribution was used to establish the cutoff times that each unit will wait before abandoning a task. Establishing these cutoff times is called fine tuning. (auth)

Miscellaneous

32386 (ORNL-UR-121) DOCUMENTATION OF DATA FILE: COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 70p. Dep. NTIS $6.50.

A data file was compiled to establish a base for studies of the growth of individual cities and cities classified in many different ways, e.g., by size, location, or type of economic development. The file contains estimates of population change components by age, sex, and color for 1,905 incorporated cities that had 10,000 or more inhabitants in 1970 and 2,500 or more inhabitants in 1960. (auth)

32387 (SAND-74-0366) AUTOMATION OF ENVIRONMENTAL TEST FACILITIES. Darsey, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. AT(29-1)-789. 10p. Dep. NTIS $4.00.

The basic considerations at Sandia Laboratories on whether to automate test facilities include total cost, accuracy, control, speed, flexibility, useful life, reliability, and ease of operation and modification. Four operational systems illustrate different philosophies in application. Also explored are trade-offs in automatic facilities, such as hardware versus software, programming languages, and the influence of the number of systems. (auth)

32388 (STI/DOC-10/162) NUCLEAR SCIENCE TEACHING. [Part] III. Report of a Panel Held in Athens, 7–11 May 1973. (International Atomic Energy Agency, Vienna (Austria)). 1975. 32p. IAEA $3.00.

The General Conference of the International Atomic Energy Agency at its tenth regular session resolved to work closely with UNESCO in education and training. The third Panel of Experts held its meeting in Athens May 7 to 11, 1973 to promote the teaching of nuclear science, particularly in biological and agricultural sciences at the high school and early university levels and those working to ensure that society knows about the benefits from the role that nuclear science can play in agriculture and biology. The status of nuclear science teaching is reported for Czechoslovak Socialist Republic, Denmark, Ethiopia, Federal Republic of Germany, Finland, France, Ghana, Greece, Israel, Lebanon and other Arab countries, The Netherlands, Nigeria, Sudan, Sweden, Syria, Tanzania, Tunisia, Turkey, Yugoslavia, and Zambia. Recommendations and an Implementation plan are presented. (MCW)

32389 IEEE RECOMMENDED PRACTICE FOR EMERGENCY AND STANDBY POWER SYSTEMS. IEEE Std 446-1974. New York; John Wiley and Sons, Inc. (1974). 109p. $9.95.

The publication presents the recommended engineering principles and practices for the selection and application of emergency and standby power systems. Industrial and commercial user needs and recommended solutions to those needs are detailed. The effects of electrical disturbances require close cooperation between the industrial or commercial user, the electric utility, and the equipment manufacturer. Those responsible for reliable plant operation will find general operational needs itemized with the recommended technical parameters of the electric power supply required. Commercial facility designers, operators and owners will find operational needs listed, with references to mandatory requirements of laws, regulations, codes, and standards. Electrical utility companies can utilize the "General Need Guidelines" in identifying the continually changing user requirements for continuous power within close tolerances. Equipment manufacturers and system engineers will find information in the "General Need" section which will assist them in designing the necessary hardware and systems to fulfill the requirements. Specific technical and economic information is included on available equipment and systems with recommendations to meet the requirements for various types of installations. (MCW)

Chemistry

32390 (BNL–19519) LITERATURE REVIEW ON THE GENERATION OF CARBON MONOXIDE FROM CARBONS. Yang, R. T.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1974. 32p. Dep. NTIS $4.75.

The fundamentals of the oxidation reactions of carbon by CO_2 and H_2O are reasonably understood and agreed upon. The reaction of $C + O_2 \rightarrow CO + CO_2$ is not totally understood. This review will include mainly the $CO_2 + C \rightarrow 2CO$ reaction and $C + O_2 \rightarrow CO + CO_2$ reaction. Practical aspects, with emphasis on the CO/CO_2 ratio, of the oxidation reactions are also included. Fuel beds are touched upon. Special attention has been paid to means of maximizing the CO/CO_2 ratio. The CO/CO_2 ratio from various gasifiers is surveyed and discussed. (auth)

32391 (CEA-CONF-2710) EVALUATION OF RESIDUAL FERROUS CHLORIDES BY PREPARATION OF INOX PIECES BY POWDER METALLURGY. Schweiger, D.; Lacour, A.; Accary, A.; Francois, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). 15 May 1974. 22p. (In French). (CONF-740585-1). Dep. NTIS (US Sales Only) $4.25.

From 13th meeting of special steels; Saint-Etienne, France (16 May 1974).

Large quantities of ferrous chloride anhydride are obtained as a by-product in the refining of Ni by the chloride process. This ferrous chloride is not amenable to classical metallurgical processes for the production of iron oxide. A powder metallurgy technique is evaluated for the processing of the ferrous chlorides.

The procedure used for the atomization of a solution of Fe, Cr, and Ni chlorides is described. The mixed chloride powder obtained is characterized. A theoretical study is made of the reduction of these chlorides and the reduction studies made are described. The feasibility of the procedure outlined for the powder metallurgical processing of ferrous chloride anhydride is discussed. (JSR)

32392 (COO-913-58) ELECTRON IMPACT SPECTRA OF SOME SATURATED HYDROCARBONS. Kim, K.; Johnston, D. B.; Lipsky, S. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry). 1974. 14p. Dep. NTIS $4.00.

Energy-loss spectra are reported for methane, ethane, propane, n-butane, n-pentane, 2-methylpentane, 2,3-dimethylbutane, and cyclohexane at a scattering angle of 0° and electron impact energy of 50 eV. Where comparisons are available with spectra obtained at higher impact energies there appears no evidence for appreciable energy dependence. Additionally the 50 eV spectra when appropriately corrected as suggested by the Born approximation agree well with optical spectra. A shoulder on the low-energy side of the first major peak of ethane, propane, n-butane, and n-pentane shifts with increasing number of alkane carbon atoms as do the first three peaks and is attributed to a predominantly C-C excitation. Nothing additional in the spectra of the non-cyclic hydrocarbons was found in the region from 2 to 7 eV. (auth)

32393 (LA-UR-75-133) DIGITAL ENHANCEMENT OF BIOMEDICAL RADIOGRAPHS. Trussell, H. J.; Janney, D. H.; Hunt, B. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 5 Feb 1975. Contract W-7405-Eng-36. 19p. (CONF-750211-1). Dep. NTIS $4.00.

From biomedical symposium; San Diego, California, USA (5 Feb 1975).

Digital image enhancement was applied to various types of anatomical radiographs in order to render obscure details readily perceptible. Radiographs showing soft tissue detail, bone detail, dental features, and radiopaque blood dyes were studied. The enhanced radiographs are useful for biological research for they reveal details in living tissue that are normally observable only in sectioned and preserved specimens. Quantitative measures of fine anatomical details such as blood passage size are possible. In time, these techniques should find their way from research applications to the clinical environment. An immediately desirable clinical application is the enhancement of portal radiographs as used in high-energy cancer therapy. Examples of anatomical radiographs showing these various applications will be displayed. The mathematical algorithms used for the various enhancements will be presented. These algorithms include both linear and nonlinear processes. Comparisons of digital methods to optical and electronic methods of enhancement will be made. These latter methods are generally faster, but suffer from lack of the general flexibility of a digital computer. (auth)

Life Sciences

32394 (BNL-19474) EXPERIMENTAL DATA ON PARTICULATE DISPERSION INTO AND WITHIN A FOREST. Part III. Dispersion from Sources Within and Above the Forest. Raynor, G. S.; Hayes, J. V.; Ogden, E. C. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1974. 48p. Dep. NTIS $5.25.

Dispersion and deposition of ragweed pollens and Lycopodium spores emitted from point sources within and above a 10- to 13-m tall pine forest were studied in a series of 47 tests under various meteorological conditions. (CH)

32395 (CEA-CONF-2552) PART I. VERIFICATION OF NEUROPHYSIOLOGICAL SIGNAL FORMS IN REAL TIME. PART II. STUDY FOR A REAL-TIME DETECTION AND SORTING OF ACTION POTENTIALS IN MULTIUNIT RECORDING. Hugelin, A.; Dupoirier, G.; de Cosnac, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). 1973. 25p. (In French). (CONF-731164-1). Dep. NTIS (U. S. Sales Only) $4.25.

From information meeting on biomedical electronics; Saclay, France (27 Nov 1973).

Problems encountered in electrical measurements for studies of the physiology of the nervous system in mammals are discussed. Improvements in impulse detection and recording systems are described. (CH)

32396 (CONF-750119-1) SOCIAL IMPLICATIONS OF MAMMALIAN EMBRYOLOGY. Leibo, S. P. (Oak Ridge National Lab., Tenn. (USA)). 1975. 20p. Dep. NTIS $4.00.

From AAAS annual meeting on health policy and research; New York, New York, USA (27 Jan 1975).

Certain areas of biological and medical research are cited as examples in which possible social impact or potential hazards require that the research be delayed or halted completely. Examples include research in some aspects of molecular genetics, cloning, chromosome analysis, and aminocentesis. Another such area is that of mammalian embryology and, specifically, those aspects that deal with in vitro fertilization of human eggs and the transfer of these eggs into women with the eventual goal being the birth of live babies. The potential benefits to man of some of these studies are discussed. (CH)

32397 (ORNL-EIS-75-73) STRIPED BASS: A SELECTED, ANNOTATED BIBLIOGRAPHY. Pfuderer, H. A.; Talmage, S. S.; Collier, B. N.; Van Winkle, W. Jr.; Goodyear, C. P. (comps. and eds.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 163p. Dep. NTIS $11.25.

The 479 references in this bibliography of striped bass and East Coast legislation affecting striped bass were collected for researchers in environmental sciences. (auth)

32398 (ORNL-TM-4773) OPTICAL PROPERTIES OF NUCLEIC ACID BASES IN THE SOFT X-RAY REGION. Juan, S. I.; Arakawa, E. T.; Williams, M. W.; Inagaki, T.; Hamm, R. N.; Emerson, L. C.; Birkhoff, R. D. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 79p. Dep. NTIS $7.00.

Thesis. Submitted by S. I. Juan to Univ. of Tennessee, Knoxville.

Optical properties were determined for the nucleic acid base adenine in the energy range from 2 to 82 eV, and for thymine, cytosine, and uracil in the energy range from 25 to 82 eV. (auth)

32399 (TID-26729) DISAPPEARANCE OF DACRYODES EXCELSA LEAF LITTER IN A TROPICAL MONTANE RAIN FOREST OF PUERTO RICO. La Caro, F. (Puerto Rico Nuclear Center, Mayaguez). Dec 1974. 45p. Dep. NTIS $5.25.

Thesis.

The rate of leaf disappearance was measured on Tabonuco leaf litter in the Luquillo National Forest near El Verde Station located in the northeastern part of Puerto Rico, at 385 meters of elevation. (auth)

32400 (TID-26733) DEVELOPMENTAL APPROACH TO THE STUDY OF IMMUNOLOGIC TOLERANCE. Comprehensive Report, April 1, 1968-February 28, 1975. Hyde, R. M. (Oklahoma Univ., Oklahoma City (USA). Dept. of Microbiology and Immunology). 1975. Contract AT(40-1)-3792. 11p. Dep. NTIS $4.00.

The induction of immunological tolerance in mice to gamma globulin from different mammalian species was studied. (CH)

32401 EXPERIMENTAL STUDIES ON THE MORPHOGENESIS IN THE VEGETATIVE SHOOT APEX. Soma, K. (Tokyo Univ. of Fisheries). Gamma Field Symp.; No. 12, 83-96(1973).

From gamma field symposia on induced mutation and chimera in woody plants; Ohmiya-Machi, Japan (26 Jul 1973). See CONF-730748-.

The following topics in the recent experimental studies of morphogenesis in the vegetative shoot apex were presented and discussed. Marking experiments on the central cells of the shoot apex of Lupinus albus, either by puncturing them or by applying a minute carbon spot on them, revealed that these cells were shifted toward the flank of the apical dome and eventually became a part of the surface of the leaf or stem during a prolonged period of growth. If the central portion of the shoot apex is isolated from the surrounding tissues and leaf primordia by vertical incisions, it is capable of continued normal growth and development. If the apical meristem is split by a vertical incision, two new shoot apices are usually regenerated from the flanks of the original meristem. Bisection of the apical meristem with decussate phyllotaxis led to the development of new shoots with spiral or other types of phyllotaxis. Excised shoot apices or apical meristems of ferns, gymnosperms and angiosperms have been successfully grown in vitro on adequate culture media to be complete plants. There is a correlation between the developmental stage of the shoot apex at the time of 2,4-D treatment and the induced morphological abnormalities, and that the shoot apex is most susceptible to 2,4-D at the maximal area stage of plastochron. Above mentioned and many other studies on morphogenesis in the shoot apex have shown that the apical meristem appears to have self-determining and autonomous properties in regard to the morphogenetic potentialities. Both structure and physiological state of the shoot apex may vary periodically during a plastochronic cycle, and many of constituent cells of the apical meristem may be renewed, as they move toward the flank and contribute to the formation of new organs. Therefore, the shoot apex can be regarded as a dynamic system of growth and differentiation. (auth)

32402 STRUCTURE OF THE SHOOT APEX WITH SPECIAL REFERENCE TO CHIMERA FORMATION. Hara, N. (Tokyo Univ.). Gamma Field Symp.; No. 12, 97-112(1973).

From gamma field symposia on induced mutation and chimera

in woody plants; Ohmiya-Machi, Japan (26 Jul 1973). See CONF-730748-.

Studies were conducted on the shoot apex. Various theories were discussed: the apical cell theory, the histogen theory, the tunica-corpus theory, the concept of cytohistologic zonation, and the "méristème d'attente" theory. Three fundamental types of the shoot apex were proposed: the apical cell type, the apical cells type, and the layers type. The first type is common in pteridophytes; the second, in gymnosperms; and the third, in angiosperms. There are also various intermediate types. Periclinal and sectorial cytochimeras were mainly discussed. Studies on chimeras, especially on sectorial chimeras, may be effective for an analysis of the phyllotaxis and the apical sector, and also for an estimation of the activity of the central zone of the shoot apex. (auth)

Materials

32403 (COO-1198-1139) ELECTRON MICROPROBE STUDY OF THE COMPOSITION OF TARNISH FILMS ON COPPER–ZINC, COPPER–ALUMINUM, AND COPPER–NICKEL ALLOYS. Gabel, H. (Illinois Univ., Urbana (USA)). Jan 1974. Contract AT(11-1)-1198. 33p. Dep. NTIS $4.75.

Thesis.

The stress-corrosion cracking of alpha-phase copper alloys in the presence of aqueous ammonia is a common industrial failure and the structure and morphology of the tarnish that is formed in Cu–30Zn are studied. A review of theories on the mechanisms of tarnish growth was made, but a recent model of tarnish formation, called the dissolution-reprecipitation model, is discussed. In this model, it is assumed that the platelets of tarnish are permeated with solution and that the anodic dissolution of metal takes place at the metal tarnish interface while the cathodic reaction, the reduction of cupric complex ions, takes place at the tarnish surface and is supplied with electrons, generated by the oxidation of the metal, by conduction through the tarnish film. A concentration gradient of cuprous ions is thought to exist across the tarnish, such that the solubility of cuprous oxide is exceeded only at or near the metal-tarnish interface. It is expected that the tarnish would be depleted of zinc. Electron-probe studies strongly supported this model and indicated that the tarnish is essentially solute depleted. The microprobe analysis was extended to other alpha-phase copper alloys, namely Cu–Al and Cu–Ni. (MCW)

32404 (CRN-CNPA-74-05) PHASE TRANSITIONS AND MOESSBAUER EFFECT. Asch, L. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1974. 198p. (In French). Dep. NTIS (US Sales Only) $13.00.

Thesis. Submitted to Strasbourg Univ., France.

Phase transitions induced by hindrance of rotational motion are investigated and emphasized on hexamines of divalent metals. These compounds are of special interest because of the motion of the NH_3 groups in the solid state. The freezing of the motion below a critical temperature necessitates a structural deformation. Using the Moessbauer effect as a tool to observe the change in the symmetry of ^{57}Fe accompanying the freezing of NH_3 groups, the phase transition in these compounds was established. It was corroborated by DTA and x ray investigations. These results associated to data of various techniques (EPR, thermal conductivity, dielectric losses) allow a beginning of coherent description of the phase transition. Detailed temperature dependences of the quadrupole interaction and Moessbauer resonance fraction revealed the cooperative nature of this phase transition. Scattering of acoustic phonons by the NH_3 liberons and fluctuating crystal fields near the critical temperature is suggested. A large number of solids, including biomolecules, have rotating molecular groups. The present work demonstrates the availability of the Moessbauer effect as a tool in the microscopic investigations of the motion aspects in such solids. (FR)

32405 (LBL-2284) FLUID FLOW PATTERNS AND SOLVENT SELECTION FOR LIQUID PHASE EPITAXIAL CRYSTAL GROWTH ON ROTATING CRYSTALS. Chen, P. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 11 Dec 1974. Contract W-7405-eng-48. 90p. Dep. NTIS $7.50.

Thesis.

Fluid flow conditions and thermochemical properties of solvent systems were studied for solution crystal growth in rotating systems. Fluid flow patterns were studied with time-lapse photography using the dye-tracer method for flow delineation. Simulation of solution crystal growth and Czochralski crystal growth revealed that the convection currents induced by crystal rotation in a stationary and slowly co-rotating crucible provided the best mixing conditions at the crystallization interface. The boundary layer beneath the crystal became more uniform and thinner as the crystal rotation rate increased. The dimensions of the crystal boundary-layer cell and overall mixing rates were reduced by counterrotation of the crucible. The overall convective mixing rate was lowest for co-rotation of the crystal and crucible with comparable angular velocities. The mixed solvent system $PbO_x(BaO \cdot B_2O_3)_{1-x}$ was investigated theoretically and experimentally for conditions allowing congruent saturation of rare-earth magnetic garnets and efficient liquid phase epitaxial growth. High quality $Eu_1Er_2Ga_{0.7}Fe_{4.3}O_{12}$ films were obtained from solvents containing 10 mole % garnet oxides. (auth)

32406 (LBL-3240) FRACTURE OF BRITTLE SOLIDS UNDER MULTIAXIAL AND DYNAMIC LOADING. Vardar, O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1975. Contract W-7405-eng-48. 116p. Dep. NTIS $9.00.

Thesis.

Weibull's statistical treatment is employed in studying the behavior of brittle solids under static multiaxial loading. The response of cracks to short duration tensile loading is examined, and a new theory is developed for predicting failure in brittle solids due to uniaxial dynamic loading. It is pointed out that the Weibull multiaxial treatment of brittle strength contains limitations which are not present in the more familiar uniaxial formulation. Provided these limitations are satisfied, it is possible to use tension or bending data to predict multiaxial behavior when at least one principal stress is tensile. This is illustrated for the Brazilian disk test (diametral compression of a disk). Predictions based on bending tests agree well with observed strength values in disk tests on two types of rocks. The failure mechanism of brittle solids under very short duration loading is basically different from that under static loading. Many cracks have to be initiated and propagated at the same time so that they can link up and create a fracture surface before the pulse is over. A simple, new theory is proposed which relates the strength of brittle solids to the duration of the applied loading. Results from the experiments in which rocks are exposed to intense short duration electron beams are predicted successfully using this theory. (auth)

32407 (LBL-3565) EFFECT OF POROUS BARRIERS ON THE MOLECULAR COMPOSITIONS OF REACTIVE GAS MIXTURES. Mohazzabi, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1975. Contract W-7405-eng-48. 63p. Dep. NTIS $6.25.

Thesis.

The effect of a porous barrier on the molecular composition of a gas mixture, when a pressure-dependent chemical reaction can take place among the components of the gas, is studied. Mass spectrometric studies on sodium chloride monomer-dimer reaction through porous alumina were employed to verify the predictions. NaCl and zinc showed the same transmission coefficient through a porous layer and indicates simple pore effusion is the only significant mode of transport through the porous barriers. The technique was used to reduce the ratio of dimer to monomer of lithium fluoride. The mass spectrometric fragmentation pattern of the monomer was then studied in order to re-examine a reported deviation from the mass spectrometric specificity rule for the monomer. (MCW)

32408 (LBL-3619) μ^+ STUDIES OF CRITICAL SPIN FLUCTUATIONS IN Ni. Patterson, B. D.; Nagamine, K.; Bucci, C. A.; Portis, A. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 6p. (CONF-741202-15). Dep. NTIS $4.00.

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974).

Critical fluctuations above the Curie point in nickel were studied by observing the relaxation of the free precession of positive muons. The work was prompted by the apparent discrepancy in nickel spin correlation time as determined by neutron scattering and by perturbed angular correlation (PAC) experiments. Up to 20 K above the Curie point, a temperature dependence in agreement with that determined from PAC was obtained. At higher temperatures the computed nickel spin correlation time becomes independent of temperature. The observed high temperature muon relaxation time of 16 μsec is very much shorter than expected from either the observed contact field at the low temperature muon site or from classical dipolar coupling to the muon nearest neighbors. The increased relaxation rate may arise from an enhanced pseudodipolar interaction. (auth)

32409 (MHSMP-74-20-C(Rev.1)) RDX/SYLGARD. Period Covered: April–June 1974. Slape, R. J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 7p. Dep. NTIS $4.00.

Analysis for HMX content of the 22 kg batch of purified RDX was completed along with the compositional analysis of 80/20, 85/15, and 90/10 RDX/Sylgard batches made from a large 4-kg

batch precipitated from the purified RDX. One copper cylinder test on 85/15 RDX/Sylgard was fired. In conjunction with the efforts to obtain detonation pressure versus composition for RDX/Sylgard, a two-shot aquarium series on 80/20 RDX/Sylgard was fired and efforts were begun on a similar series for 90/10 RDX/Sylgard to supplement the previously fired 85/15 RDX/Sylgard. Preliminary optimum time and temperature for cure data was generated. Outside orders for Sandia closely related to RDX/Sylgard evaluation were completed with the loading of stainless steel driver subassemblies for Sandia, Albuquerque. (auth)

32410 (MHSMP-74-35B) FILLERS, POTTING, AND ADHESIVE COMPOUNDS. Period Covered: July–September 1974. Montague, J. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $4.00.

In an attempt to find a replacement for the Adiprene/MOCA urethane gluing and casting system, several materials were investigated. The following urethanes were evaluated: Adiprene 315, Adiprene 315/Anifoam 70, Stycast CPC18, Stycast CPC19, Isochem UE 1527, and Uralite 3121-S. Uralite 3121-S proved to be the most promising candidate because of ease of processing and fast cure rate. (auth)

32411 (MHSMP-74-35C) EVALUATION OF URALITE 3121-S. Period Covered: July–September 1974. Montague, J. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 7p. Dep. NTIS $4.00.

In an attempt to find a replacement for the Adiprene/MOCA system several urethanes were investigated. Of those materials studied, Uralite 3121-S displayed exceptional promise because of its physical characteristics. At the present time it appears that Uralite 3121-S could possibly replace the Adiprene/MOCA system as an adhesive, but not as a casting or molding resin. (auth)

32412 (MHSMP-74-35D) PETN/LX-13 PROCESSING. Period Covered: July–September 1974. Locke, J. G.; Osborn, A. G.; Stallings, T. L.; Duncan, A. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 3p. Dep. NTIS $4.00.

LX-13 was prepared from a 2 kg batch of PETN made by continuous precipitation. The extrudability of the LX-13 in 20- and 35-mil tracks was acceptable but low in the 15-mil track. (auth)

32413 (MHSMP-74-35E) RDX/SYLGARD. Period Covered: July–September 1974. Slape, R. J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 13p. Dep. NTIS $4.00.

Three batches of 85/15 RDX/Sylgard 182 were formulated, the first of which was extremely tacky, prompting the formulation of the other two in an effort to determine the cause for the unusual tackiness. The three-shot aquarium series to determine detonation pressure versus composition of RDX/Sylgard was completed. Detonation velocity versus aging studies continued with the firing of the first aged samples (3 months at 80 and 100 C). An outside order for Sandia related to the evaluation of 85/15 RDX/Sylgard was completed with the fabrication of RDX/Sylgard pads for evaluation by Sandia. During fabrication of the RDX/Sylgard pads using the tacky batch mentioned above, indications of separation of the HE and binder phase were noted, suggesting a possible test to measure separation. (auth)

32414 (MHSMP-74-35F) ECX AND PEX RHEOLOGY. Period Covered: July–September 1974. West, G. T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 10p. Dep. NTIS $4.00.

The principal factors that affect the apparent viscosity measurements of RDX/Sylgard made with the Instron MCR Capillary Rheometer were determined. It was found that capillary length, diameter, and speed accounted for the most important sources of variation in load. (auth)

32415 (MHSMP-74-35G) EXTRUDABLE EXPLOSIVES: COMPATIBILITY. Period Covered: July–September 1974. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $4.00.

The long-term compatibility study of RDX/Sylgard with some other weapon materials is continuing. Some decomposition was indicated after six months at 353 and 373 K by a slight increase in the amount of CO_2. The 373 K coupon assembly also had N_2O present. (auth)

32416 (MHSMP-74-35H) STATISTICAL ANALYSIS OF PBX 9404 PRESSING DATA. Period Covered: July–September 1974. Ashcraft, R. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 15p. Dep. NTIS $4.00.

The report describes a statistical analysis performed on two sets of data resulting from PBX 9404 billets pressed at various conditions. The first data set (sieve analysis results) was obtained from billets pressed at different pressures with preheat temperature and dwell time held constant. Graphical analysis and 95% confidence intervals for sample means were used to analyze the mean particle size as a function of pressure. A specific pressure at which maximum mean particle size occurred was not evident in the analysis. The second data set (physical properties) was obtained from tensile specimens from billets pressed at a constant pressure while preheat temperatures and dwell times were systematically varied. Factorial analysis was used to obtain the relationship between density (ρ) and the process variables preheat temperature (T) and dwell time (t): $\rho = A_0 + A_1T + A_2T^2 + A_3t + A_4t^2 + A_5Tt + A_6T^2t^2$. Factorial analysis could not be used on the failure stresses and strains for the tensile specimens because these data were incomplete. Graphical and linear regression methods were used to show that failure stress increases as preheat temperature increases. Stress is independent of dwell time and strain is independent of both process variables. (auth)

32417 (MHSMP-74-35I) SKID TEST EVALUATION OF RX-04-EP. Period Covered: July–September 1974. Van Velkinburgh, J. H. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 4p. Dep. NTIS $4.00.

Skid testing was performed on RX-04-EP (96.2/3.8 HMX/Estane 5702-F1) to determine more clearly the HMX percentage where the sensitivity abruptly changes between an HMX weight percentage of 96 and 97. Sensitivity of the RX-04-EP is closely akin to the 96 percent HMX formulation. Previous data for 96, 96.6, and 97 percent HMX formulations are included for comparison. (auth)

32418 (MHSMP-74-35K) PASTE EXPLOSIVES: COLD STAGE FOR LOW-TEMPERATURE THERMOMICROSCOPY STUDIES. Period Covered: July–September 1974. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 3p. Dep. NTIS $4.00.

A microscope cold stage was designed for studying the crystallization and solid-liquid phase diagrams of liquid carriers proposed for past explosive systems. This cold stage utilizes thermoelectric cooling devices to maintain a low temperature for extended periods of time. (auth)

32419 (MHSMP-74-35L) TATB PILOT PLANT ACTIVITIES FY 75. Period Covered: July–September 1974. Quinlin, W. T.; Evans, V. H.; Estes, Z. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 9p. Dep. NTIS $4.00.

During the first quarter of FY 75, the HE synthesis facility has produced 1590 kg of TATB, sym-triaminotrinitrobenzene, and 2450 kg of TCTNB, symtrichlorotrinitrobenzene. This material is being produced for LLL, LASL, and Pantex NPD work. In order to improve both TATB output and quality, the operating conditions were varied over a narrow range. An optimum agitation range was determined for the current amination vessel. Low concentrations of TCTNB in the amination solvent produces low percentages of fine TATB particles. (auth)

32420 (MHSMP-74-35M) TATB PROCESS STUDIES. Period Covered: July–September 1974. Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 14p. Dep. NTIS $4.00.

The resistance of TATB to the effect of solvents inhibits its purification through recrystallization. This has prompted the study on the purification of reagents and/or intermediates involved in the synthesis of TATB. Long-term digestion of TATB in boiling water is shown to significantly reduce chlorine content. (auth)

32421 (MHSMP-74-35N) NMR ANALYSIS OF TATB. Period Covered: July–September 1974. Clink, G. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $4.00.

An NMR method for the total proton analysis of TATB, including the ammonium content, was effected using concentrated sulfuric acid as the solvent and the internal lock material. An approximate solubility of bulk TATB in concentrated sulfuric acid at room temperature (25 C) was found to lie between 12.8 and 13.0% (~265 kg/m³ of sulfuric acid). (auth)

32422 (MHSMP-74-35-O) HE PARTICLE CHARACTERIZATION. Period Covered: July–September 1974. Giberson, R. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $4.00.

A number of samples of TATB were run on the automatic particle analyzer and compared to wet sieve analysis. (auth)

32423 (MHSMP-74-35P) PARTICLE CHARACTERIZATION OF TATB. Period Covered: July–September 1974. Duncan, A. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 7p. Dep. NTIS $4.00.

The characterization of TATB has been done by both the Quality and Development Divisions. TATB characterization by the Quality Control Laboratory was made by a microscope system called the Millipore Particle Measurement Computer. The system measures maximum horizontal chords from which frequency distributions are generated; by assuming shape, weight/size distributions can also be derived. TATB characterization by the Development Division has used sieve analysis, microscopy and specific surface analysis. A comparison of the results obtained by the Millipore and sieve analysis for TATB is made in this report as well as the repeatability of each technique. Thus far, the results obtained by the two methods appear to be significantly different. Repeatability exhibited by the two methods indicates that sieve analysis is better than the Millipore technique. (auth)

32424 (MHSMP-74-35Q) TATB PBX FORMULATION. Period Covered: July–September 1974. Stallings, T.; Osborn, A. G. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $4.00.

In support of LLL requirements, thirteen TATB PBX lots were made by the slurry method to supply material for pressing evaluations, sensitivity tests, and LLL and Air Force programs. For much of this work large uniform blends of raw powder were used. (auth)

32425 (MHSMP-74-35R) PRESSING STUDIES OF THREE TATB/BINDER SYSTEMS. Period Covered: July–September 1974. Harrell, J. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 10p. Dep. NTIS $4.00.

Pressing processes and resultant billet densities are presented for several formulations each of three different TATB/Binder systems. Densities were found to generally increase as the compaction pressure and/or dwell period was increased. An unexpected fine textured corrosion on the inner surfaces of the Elmes press resulted from the pressing of these formulations. (auth)

32426 (MHSMP-74-35S) MECHANICAL PROPERTIES OF EXPLOSIVES. Period Covered: July–September 1974. Johnson, H. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 24p. Dep. NTIS $4.25.

The density of TATB formulations with Estane, Viton, and Kel-F binders was slightly increased by subjection to the bartherm treatment. However, the TATB specimens that were bartherm treated in ethylene glycol showed a decrease of 2 to 7 kg/m^3. It was observed that surface cracks (approximately 2 mm deep) appeared on all the specimens heat treated in tap water and ethylene glycol. Test results showed that the growth of TATB specimens that were temperature cycled (–54 C to 74 C) were not significantly decreased by the bartherm treatment. (auth)

32427 (MHSMP-74-35T) TATB SENSITIVITY TESTING. Period Covered: July–September 1974. Kramer, P. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 8p. Dep. NTIS $4.00.

A gap test configuration was established in which TATB (in both pure and PBX forms) displays a reasonable level of sensitivity at a minimum consumption of HE. Test results appear both consistent and reproducible. (auth)

32428 (MHSMP-74-35U) THERMAL PROPERTIES AND COMPATIBILITY OF TATB AND TATB/BINDER SYSTEMS. Period Covered: July–September 1974. Myers, L. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $4.00.

The linear coefficient of thermal expansion was determined for three TATB-based plastic bonded explosives, containing Estane, Viton, and Kel-F 800 binders. Some preliminary work was begun to evaluate methods of determining the compatibility of TATB. (auth)

32429 (MHSMP-74-35W) SENSITIVITY AND PERFORMANCE TESTING OF HIGH EXPLOSIVES. Period Covered: July–September 1974. Kramer, P. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 3p. Dep. NTIS $4.00.

Continued efforts to measure the C-J pressure of HE's in an aquarium test utilizing the detonation electric effect (DEE) resulted in limited progress, but the problem of obtaining consistent results may have been solved. (auth)

32430 (MHSMP-74-35Y) DINITROFLUOROETHYLFORMAL (FEFO) DETERMINATION IN SLT MATERIALS. Period Covered: July–September 1974. MacDougall, C. S. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $4.00.

A spectrophotometric determination of fluoride was adapted to the determination of dinitrofluoroethylformal (FEFO) in SLT materials. The procedure includes conversion of the covalent fluorine in FEFO to fluoride, followed by spectrophotometric determination of the fluoride. The amount of FEFO is then calculated from the fluoride found, assuming a stoichiometric relationship. Approximately 10 samples, in duplicate, can be analyzed in an 8-hour day. The method is sensitive to 1 μg of FEFO. Analysis of a "standard" silastic, prepared to contain known quantities of FEFO, showed recovery of FEFO to be 98 percent. The relative standard deviation of this method is ±4 percent for measuring 100 μg amounts of FEFO. (auth)

32431 (NP-20322) 1973–1974 SALINE WATER CONVERSION SUMMARY REPORT. (Department of the Interior, Washington, D. C. (USA)). 1974. 64p. GPO $1.55.

An agreement between the United States and Mexico to resolve the salinity problems of the Colorado River at the border was reached August 30, 1973, calling for delivery of water at Morelos Dam (where most of Mexico's irrigation water is diverted from the Colorado), which does not exceed in salinity by more than 115 ± 30 ppm that water which arrives at the Imperial Dam from the Colorado River. The construction of the world's largest desalting plant here will treat the return flows from the Welton-Mohawk Irrigation and Drainage District. The design of the desalting plant is based on recovering 70% of the saline return flows being treated. Research is being directed toward development of the membrane processes for seawater, on the freezing processes, and others, with research being directed from distillation. The status of the thermal and membrane research processes is discussed. Water resources have become an important consideration for processing coal and oil shale. The reuse of that water and the disposal of aqueous wastes affords new opportunity for utilization of desalting technology. (MCW)

32432 (ORNL-tr-2880) FURTHER DEVELOPMENTS OF THE ALUMINUM WELDING PROCESS. 1963. Translated by R. G. Mansfield, Oak Ridge National Lab., TN, from pp. 341-345 of Proceedings of the Symposium on Electron Vacuum Physics. 4p. Dep. NTIS $4.00.

The results obtained from research on the development of aluminum welding are summarized and it is concluded that the fabrication of metal-ceramic joints could be simplified by avoiding the application of an alkaline intermediate layer and the process could be applied to porcelain-metal joints. Systematic studies of the mechanical and thermal strength were made on all types of joints. The process is described and the advantages and disadvantages are discussed. (MCW)

32433 (ORO-4703-3) INTERACTION OF SLOW ELECTRONS WITH HIGH-PRESSURE GASES (QUASI-LIQUIDS); SYNTHESIS OF OUR KNOWLEDGE ON SLOW-ELECTRON INTERACTIONS WITH BENZENE AND ITS DERIVATIVES. (Tennessee Univ., Knoxville (USA). Dept. of Physics). 1975. Contract AT(40-1)-4703. 5p. Dep. NTIS $4.00.

An investigation of the roles of the physical and chemical properties of molecules in biological reactions was made. These isolated molecule properties change as molecules are embedded in gradually denser and denser gaseous, and finally, liquid environments. High-pressure (300 to about 100,000 torr) electron swarm experiments are in operation yielding the first information as to the effects of the density and the nature of the environment on electron-molecule interaction processes. Synthesis of current knowledge on slow-electron interactions with benzene and its derivatives is reported. Other progress on the attachment of slow (10 eV) electrons to SO_2 in N_2 (300 to 25,000 torr), C_2H_4 (200 to 15,000 torr), and Ar (500 to 2,000 torr) gases was investigated. (MCW)

32434 (SAND-74-5541) ADHESIVE PROPERTIES OF URETHANE RESIN. DeLollis, N. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 11p. (CONF-750412-1). Dep. NTIS $4.00.

From spring meeting of SAMPE; San Diego, California, USA (15 Apr 1975).

The report describes the adhesive and bulk properties of a polyol-cured methylene diphenyl diisocyanate (MDI) urethane resin system being evaluated as a replacement for a MOCA-cured urethane resin system. In order to verify that the adhesive aging studies do describe interfacial rather than bulk phenomena, shear moduli of the bulk resin system were studied with and without aging. The adhesive strength properties were evaluated at

room temperature with and without aging at 74°C and at constant high humidity with thermal cycling. In addition, the durability of the bond is evaluated with and without the addition of an epoxy terminated silane primer. The adhesive strength properties with and without the primer are essentially the same for unaged specimens. Those specimens bonded with the urethane resin to which the primer is added show considerable improvement in bond strength compared to the nonprimed urethane when exposed to both thermal and humidity aging. The bulk properties as described by shear moduli did not change under these conditions. One-half percent of the silane primer added to the urethane resin results in essentially the same effect in terms of improvement of bond strength durability as does one percent added primer. (auth)

Physics and Engineering

32435 (BDX-613-1212) APT/IGS NUMERICAL CONTROL SYSTEM. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1975. Contract AT(29-1)-613. 25p. (CONF-740845-2). Dep. NTIS $4.00.

From 43rd share conference; Chicago, Illinois, USA (26 Aug 1974).

Capabilities and advantages of the Automatically Programmed Tools/Interactive Graphics System (APT/IGS) are demonstrated. Increased efficiencies were achieved in three areas of part programming: design of a specific part program; reduction of job span time; and a reduced number of defective parts. (auth)

32436 (CEA-CONF-2884) EXPERIMENTAL DEMONSTRATION OF LASER TEMPORAL COHERENCE EFFECTS ON MULTIPHOTON IONIZATION PROCESSES. Mainfray, G.; Manus, C.; Sanchez, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Atomique). 1974. 5p. (CONF-740617-9). Dep. NTIS (US Sales Only) $4.00.

From 8th international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

The multiphoton ionization probability of xenon atoms was investigated by using a Q-switched Nd-glass laser which can be operated with a variable number of adjacent longitudinal modes (from one to ten). (auth)

32437 (CEA-CONF-2885) RESONANT THREE-PHOTON IONIZATION OF POTASSIUM WITH CIRCULARLY AND LINEARLY POLARIZED LIGHT. Agostini, P.; Bensoussan, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Atomique). 1973. 5p. (CONF-740617-8). Dep. NTIS (US Sales Only) $4.00.

From 8th international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

The dependence of the resonant three-photon ionization probability of potassium on the laser wavelength is investigated, for linearly and circularly polarized light. (auth)

32438 (CEA-CONF-2886) COLLISIONS INVOLVING EXCITED SPECIES. Manus, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Atomique). Jul 1974. 4p. (CONF-740998-2). Dep. NTIS (U. S. Sales Only) $4.00.

From 2nd European study conference on atomic and molecular physics of ionized gases; Innsbruck, Austria (3 Sep 1974).

The discussion of collisions involving excited species of atoms and molecules covers the transfer of excitation, metastable collisions, and vibrational or electronic states. (JFP)

32439 (DESY-SR-74/12) PHOTOEMISSION FROM DOPED SOLID RARE GASES. Ophir, Z.; Raz, B.; Jortner, J.; Saile, V.; Schwentner, N.; Koch, E. E.; Skibowski, M.; Steinmann, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Sep 1974. 24p. INIS.

24 figs.; 5 tabs.; 35 refs.

The results of an experimental study of the photoelectric yield of doped solid rare gases in the extreme ultraviolet ($h\omega$ = 8 eV to 30 eV) spanning the range of impurity excitations, exciton states, and interband transitions are reported. Results were obtained for Xe in Kr, Xe in Ar, Kr in Ar and benzene in Ar, Kr, and Xe. For dilute atomic and molecular impurities in solid rare gases three intrinsic photoemission mechanisms are exhibited: a) direct excitation from the impurity state above the impurity threshold, b) electronic energy transfer from the host exciton states to the impurity states resulting in exciton-induced impurity photoemission, and c) direct photoemission from the host matrix at energies above the matrix threshold. The photoemission thresholds from impurity states via processes a) or b) result in detailed information regarding electron affinities of solid rare gases which are in good agreement with recent data for the pure solids. A detailed study of exciton-induced photoemission was conducted on Xe/Ar mixtures. The energy-dependent photoemission line shape at different film thicknesses and at different concentrations was analyzed in terms of a kinetic picture involving competition between energy transfer from "free" excitons and exciton trapping. A quantitative estimate of the diffusion length of Wannier excitons in solid Ar was extracted. (auth)

32440 (DL/SRF/R-1) PHOTOIONIZATION. Daresbury Synchrotron Radiation Lecture Note Series No. 1. Bottcher, C. (SEE CODE-5677740 Science Research Council, Daresbury (UK). Daresbury Nuclear Physics Lab.). Nov 1973. 53p. Dep. NTIS (US Sales Only) $5.75.

The lecture dealt with the subject under the following headings: basic photoionization theory, calculation of nonresonant photoionization cross sections, theory of resonances, photoionization of heavy atoms, photoionization of molecules. It is stated that the aim was to survey the basic ideas of the subject for an audience of experimental physicists and to introduce some current theoretical developments. (UK)

32441 (ITF-74-103P) STATISTIC THERMODYNAMICS OF CHARGED PARTICLE QUASIRELATIVISTIC EQUILIBRIUM SYSTEMS. Blazhievskii, L. F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 26p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.50.

A quasirelativistic system of charged particles in equilibrium is considered. The Hamiltonian correctly taking into account relativistic effects of $(U/C)^2$ order is obtained. The transversal interaction is of screened character. The classically free energy of a system is calculated by collective variable method. Relativistic corrections caused by the second virial coefficient are obtained. In the ring approximation of thermodynamic perturbation theory the free energy of a nondegenerated quantum quasirelativistic electron gas is calculated. Exchange and spin interactions are taken into account. (auth)

32442 (JINR-E2-8533) MATRIX CANONICAL REALIZATIONS OF THE LIE ALGEBRA SIGMA(m,n). I. Basic Formulae and Classification. Havlicek, M.; Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 26p. Dep. NTIS (US Sales Only) $4.50.

The concept of matrix canonical realization of a Lie algebra is introduced. The generators of the Lie algebra of the pseudo-orthogonal group $\sigma(m,n)$ are recurrently expressed in terms of matrices with polynomial elements in a certain number of quantum-mechanical canonical variables p_i, q_i, and they depend on a certain number of the free real parameters. The realizations are, in the well defined sense, skew-hermitean, and Casimir operators are multiples of the identity element. Part of them are usual canonical realizations. (auth)

32443 (NICP-7406) AURORAL ALL-SKY CAMERA: ELECTRONICS AND REMOTE CONTROL. Sten, T. A. (Norske Institutt for Kosmisk Fysikk, Oslo). Feb 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

An auroral all-sky camera was constructed at the Norwegian Institute for Cosmic Physics in 1973, for use at the Andøya Rocket Range. Following a general description of the mode of operation, descriptions are given of the main electronic components. These are the detector and pulseshaper, the NASA 36-bit decoder, and the camera timer. Circuit diagrams are given. In a short appendix the NASA 36-bit code format is presented. (NO)

32444 (NP-20348) CALCULATION OF ELASTIC CURRENT-CARRYING PLATES. Odintsov, V. N. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The method of calculation of current-carrying elastic plates, heated as a result of joule losses, is described. The formulae and diagrams, determining the maximum plate size on the base of tolerable flexural strength and the value of the largest overheating in the plate center are given. The longitudinal flexing of the fastened plate and flexible hinge is considered. (tr-auth)

32445 (NRO-671860(Folder 1)) PROPOSAL FOR EMERGENCY VENTING PROPULSION SYSTEM TO GEORGE C. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALABAMA. Folder 1. Technical. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Apr 1967. 267p. Dep. NTIS $16.50.

Proposed methods are described for obtaining weight flow rate and specific impulse measurements for a family of subscale nozzles providing the basic information necessary to define and optimize various emergency venting propulsion systems capable of providing ΔV requirements for ascent and orbit abort. The scope of work described in the technical discussion is divided into two phases. Phase I comprises the scope of work for the sub-orbital abort condition and includes a subscale experimental program to determine the specific impulse as a function of the tank conditions which can be obtained by emergency venting

the flight tank propellant. Phase II is an analytical study for increasing the orbital altitude from 100 nautical miles to 260 nautical miles. Summaries of the Program Plan and Project management are also included along with data on flow of two-phase parahydrogen and properties of saturated liquid rocket propellants. (JRD)

32446 (FN-FOP-0025) NERVA PROGRAM. Operating Procedure, Powerhouse Operator's Handbook. Test Cell A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Nov 1963. 37p. Dep. NTIS $5.00.

Details of powerhouse operation procedures are given. Information is included on engine pre-starting, powerhouse diesel starting, synchronization, powerhouse securing, power distribution, cooling systems, lubrication systems, and diesel fuel systems. (JRD)

32447 (SAND-75-7049) [ANALYSIS AND DESIGN OF A MICROWAVE-BIASED PHOTOCONDUCTIVE SENSOR]. Final Report on Sandia Laboratories Contract No. 63-1871. Crouch, J. N. Jr. (E-Systems, Inc., Greenville, Tex. (USA)). 16 Dec 1974. 76p. Dep. NTIS $7.00.

A trade-off analysis and design study of a microwave-biased photoconductive sensor are presented. The basic function of the sensor is to detect fast optical pulses in the visible and near-IR spectral regions. The desired characteristics of the microwave-biased photoconductive sensor are listed. The sensor design is of two general types of microwave cavities suitable for the application (reflection-type and transmission-type). A discussion of the photoconductor materials parameters that affect the sensor performance is included with a description of the sky background effective irradiance levels that might be incident upon the photoconductive active area. The electrical bandwidth of the microwave-biased photoconductive sensor and the sky background effective irradiance are considered to be the dominant variables for the trade-off analysis. Critical design equations are computer coded and calculated. Selected design equations are chosen for computer-plotting and are presented. (MCW)

32448 (SLA-73-5262) SPONTANEOUS GENERATION OF ACOUSTIC SIGNALS DURING SWITCHING OF AMORPHOUS SEMICONDUCTORS. Beattie, A. G.; Johnson, R. T. Sr.; Quinn, R. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 15p. (CONF-740911-2). Dep. NTIS $4.00.

From 5th international conference on atmospheric electricity; Garmisch-Partenkirchen, F. R. Germany (2 Sep 1974).

Studies of electrical switching in bulk semiconducting chalcogenide glasses have shown that acoustic emission (spontaneously emitted acoustic waves) is produced during the switching process. The experiments were performed on samples with compositions $Ge_{15}Te_{80}As_5$ and $Ge_5Te_{45}As_{50}$. Switching was both across the surface of the samples and through the thickness (bulk) of the samples. During switches where the current rise is faster than 30 μsec, a burst of acoustic emission is produced 2 to 25 ($\pm$2.5) μsec preceding the rise in current. This emission is associated with the initiation of the switching process. Another characteristic type of emission is seen that occurs primarily after the rise in current, and is shown to have its origin in propagating cracks in the sample. These studies give information both about the physics of the switching process and the integrity of the material after the switch. (auth)

32449 (TID/SNA-870) NERVA ALTITUDE SIMULATION SYSTEM EXHAUST DUCT SYSTEM PRELIMINARY DESIGN. Preliminary Aero/Thermo Analysis. Appendix A, Book 3 of 3. (Addendum 2, to Appendix A, F008-NAS01-W224). Margetts, M. J (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 357p. Dep. NTIS $21.00.

Design and development of an exhaust gas cooling system for NERVA reactor test stand operation is reported. Information is included on turning plenum scale model testing, water injection testing, model cooling effectiveness testing, water injection subsystem redesign, nuclear altitude simulation system performance analysis, plenum pressure losses, plenum sizing, and engine standby safety. (JRD)

32450 (TID/SNA-1269) STRUCTURAL ANALYSIS OF CYLINDRICAL PRESSURE VESSEL (CRYOSTAT) NO. 090683. Final Report. Brode, D. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1964. 54p. Dep. NTIS $5.75.

An analysis was performed to ensure the conformity of the cylindrical pressure vessel (090683) to the ASME Unfired Pressure Vessel Code. The code requires a factor of 5 on all vessels subject to external pressure. The vessel in question is a double walled cylinder utilizing a vacuum between the walls for insulation. Therefore, the factor of 5 was applied directly to the ambient pressure. For continuity of the analysis, the inner vessel, although maintaining internal pressure, was also designed to the above factor. (auth)

32451 (UCID-16657) DESIGN CONSIDERATIONS FOR PARASITIC SCREEN ANTENNAS. Bevensee, R. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jan 1975. Contract W-7405-Eng-48. 51p. Dep. NTIS $5.75.

The results of a computer study of a model of a parasitic screen antenna are described. The antenna consists of an array of N parallel wires, driven by uniform current at a sinusoidal frequency in the exciting wire parallel to the others. All wires are infinitely long. The parasitic arrays treated are planar screens, wedges or corner reflectors of half-angle 60° and 45°, and parabolic cylinders. All interactions among the wires and ohmic loss are accounted for in the computer code. The forward-to-backward field ratio F/B for planar screens is shown to be an extremely sensitive function of the wire radius/spacing ratio at a given frequency, for a given number of wires. This is consistent with the simple theory of perfect shielding of an infinite number of wires to an incident plane wave. A given array is optimized in the sense of varying the spacing between parasitics, wire radius, and position of the exciting wire at a reference frequency f_0 in order to maximize the F/B ratio. This ratio can be orders of magnitude larger than for a comparable solid screen array. For planar screen antennas it is shown to be an extremely sensitive function of frequency about the reference frequency f_0. Radiation patterns for the various optimized screens are then obtained as a function of frequency about f_0 and as a function of the number of wires at f_0. It is shown that the envelope of the pattern for a given antenna, in particular the -10 dB lobewidth, is an insensitive function of frequency in a $\pm$25% range about f_0, and also insensitive to the number of wires. It is also shown that the patterns and lobewidths are very insensitive to changes in the design parameters of a few percent about their optimized values obtained at the reference frequency. (auth)

32452 (UCID-16735) NUMERICAL ANALYSIS OF PRE-BURST TEMPERATURES IN AN EXPLODING STRIP CONDUCTOR. Logan, J. D.; Yee, K. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1975. Contract W-7405-eng-48. 81p. Dep. NTIS $7.25.

Some numerical studies on the magnitude of the electric field in bridgewire conductors and the contribution of that field to the ohmic heating of the bridge element are documented. The investigations explain the processes that occur in exploding foils prior to the time of burst. The uniformity of the bridge element heating over its area is investigated, providing a uniform initiation and propulsion to a flyer plate lying on the element. A bridge element into which a dc current is passed is considered, assuming a constant conductivity. The purpose is to obtain some results of the magnitude of the current density in the bridge in this steady-state situation. Results for this problem give some understanding of the location for initial heating in the conductor. A nonlinear problem is considered and the conductivity is allowed to vary as a function of temperature; and for this problem the current is time-dependent and the bridge element lies in a circuit with inline resistance and inductance with a capacity discharge unit providing the current surge. The actual temperature in the bridge element is calculated in the latter problem. (MCW)

32453 (UCRL-13621) CURRENT DISTRIBUTION IN STRIP CONDUCTORS. Final Report, January 1-November 30, 1974. Yee, K. S. (Kansas State Univ., Manhattan (USA). Dept. of Mathematics). 1974. Subcontract No. 4151805. 77p. Dep. NTIS $7.00.

Two efforts, the determination of the DC current distribution on a strip conductor with rectilinear boundary and the determination of the time dependent and temperature dependent current density on a strip conductor when connected with an external circuit containing in-line inductance and resistance and a capacitor bank were investigated during the time period January 1 to December 1, 1974. The study was performed to investigate the physical processes that occur in exploding foils preceding the time of burst. Various theoretical results were derived to yield closed form solution for the DC current distribution on rectilinear conductors. A numerical scheme was constructed to yield the numbers directly from various inputs. Such a code was constructed and was tested at LLL. A description of the code and its detailed operational instructions are contained in Appendix A. Next, a mathematical model for a particularly geometrically-shaped (rectangular) bridge element was investigated. The conductivity of the bridge element is assumed to depend on the temperature caused by the electric heating and the bridge element is connected to an external circuit to complete the problem. The code is given in Appendix B. (MCW)

32454 (UCRL-76437) REPORT ON THE LLL FLATNESS AND PARALLELISM GAGE. Lane, D. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Feb 1975. 24p. (CONF-750214-1). Dep. NTIS $4.25.

From IMOG meeting; Livermore, California, USA (19 Feb 1975).

The LLL Flatness and Parallelism Gage was designed to upgrade the existing flatness gage to gain parallelism in the same inspection setup. The present design includes two Beockeler supermicrometers for added versatility. The design, its versatility, accuracy, and costs are discussed. (MCW)

32455 (UCRL-76454) PROGRAMS FOR COMPUTER AIDED DESIGN OF METAL-OXIDE-SEMICONDUCTOR (MOS) LSI ELECTRONIC CIRCUITS. Alexander, E. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 6p. (CONF-741001-54). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

This paper describes a software package used in computer aided design of metal-oxide-semiconductor (MOS) large scale integrated (LSI) electronic circuits. The software is based on the Banning Design Automation system and employs the standard logic cell approach. Three computer programs are discussed: LOGSIM, PRF, and ARTWORK. The Logic Simulator (LOGSIM) is intended to provide the MOS/LSI designer with a means by which to verify a logic design prior to implementation to hardware. LOGSIM is a three-valued logic simulator, in that the indeterminate state is represented as well as logic HIGH and logic LOW. The program has an internal logic library of fifteen logic element types. The Placement-Route-Fold (PRF) program is used to translate a logic design to precision MOS/LSI artwork. The PRF program provides the engineer with an automatic method for generating a MOS chip design using a family of prespecified standard logic cells. The PLACEMENT subroutine orders the cells in a linear array to minimize interconnection lengths. The ROUTE subroutine routes the wiring of the linear array to reduce the number of interconnection crossovers. The routed array is divided by FOLD into a number of segments such that the linear array may be folded into a square array. The PRF output would now normally be transferred to an Interactive Graphics Design System (IGDS) for any corrections, additions, or updates, before going to ARTWORK. The ARTWORK program outputs binary-coded-decimal, BCD, artwork commands suitable for use with a GERBER artwork generator. These GERBER commands select the appropriate apertures and plotter motions of the photohead assembly to produce a properly exposed circuit mask. (auth)

32456 (UCRL-76458) COMPUTER GRAPHICS AS A TOOL FOR ENGINEERING ANALYSES. Brown, B. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 8p. (CONF-741001-56). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Computer graphics is a useful tool for finite element analyses. First graphics provides a quick way to verify the input geometry of the model for the analysis routine. Whether the input is prepared by hand or by a mesh generator, the input must be checked. After the analysis is performed the output must somehow be interpreted. Computer graphics provides a convenient way to present displacement and stress data. At LLL a routine known as SAMPP (Structural Analyses Movie Post Processor) performs these functions; SAMPP is a general routine for the display of two- and three-dimensional finite element models and the results of both static and dynamic analyses. The post processor may be used to produce line drawings and continuous tone pictures as well as animated line drawing movie sequences. The routine uses a Hidden Surface Processor for the display of realistic looking perspective views. (auth)

32457 (UCRL-76466) STUDIES IN LASER TARGET INTERACTION. Maiden, D. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 10p. (CONF-741001-58). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Theoretical studies in pulsed laser target interaction in an air environment are described. Calculations were conducted on both Eulerian and Lagrangian hydrodynamic codes. Calculated detonation-wave velocities are in good agreement with experiment. Scaling laws for momentum transfer to a solid target have been derived. These results were used as input for material response calculations that determine the nature of high power laser damage to aluminum plates. Impulse calculations for multiple pulses reveal no significant enhancement. Calculations of the ignition transients of Laser-Supported combustion waves reveal that hydrodynamics govern the wave speed at early times and the true wave speed must be taken relative to the hydrodynamic flow. Calculations reveal that there is an enhanced thermal coupling of energy to aluminum by a factor of three which compares with experiment. (auth)

32458 (UCRL-76513) NONSYMMETRIC HALF PLANE RECURSIVE FILTERS: CHARACTERIZATION, STABILITY THEOREM, AND TEST. Woods, J. W.; Ekstrom, M. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Feb 1975. 6p. (CONF-750408-1). Dep. NTIS $4.00.

From international symposium on circuits and systems; Boston, Massachusetts, USA (21 Apr 1975).

A new class of 2-D recursive filters with support on nonsymmetric half-planes is examined in detail. The nonsymmetry arises out of the requirement of recursive computability. This class is shown to be general in that, unlike the situation with the well known 2-D causal filters, any specified magnitude response can be approximated by a filter in this class to any given degree of accuracy. A stability requirement is formulated in terms of the location of the poles of the filters' 2-D transfer function that is then used to formulate a stability test involving a homomorphic transform and the 2-D FFT. (auth)

32459 (UUIP-851) DETERMINATION OF HYPERFINE PARAMETERS FROM $\frac{1}{2} \rightarrow \frac{3}{2}$ TRANSITIONS IN MOESSBAUER SPECTROSCOPY. Haeggstroem, L. (Uppsala Univ. (Sweden). Fysiska Institutionen). Feb 1974. 46p. Dep. NTIS (U. S. Sales Only) $5.50.

An analytical solution of the eigenvalue equation for $I = \frac{3}{2}$ with combined magnetic dipole and electric quadrupole hyperfine interactions is presented. The results were incorporated into a least squares fitting routine used for Mössbauer spectroscopy in the laboratory, and examples of fitted Mössbauer spectra are given. Useful formulas for either dominating magnetic dipole hyperfine interaction or dominating electric quadrupole hyperfine interaction were developed, and the possibility of determining the sign of eQV_{zz} is discussed in some detail. (auth)

32460 (Y-DA-5972) LOW FORCE CARTRIDGE TRANSDUCER FOR PRECISION GAGING APPLICATIONS. Gibson, J. R.; Rasnick, W. H.; Schwartz, H. S.; Steger, P. J. (Oak Ridge Y-12 Plant, Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

Cartridge-type linear variable differential transformer (LVDT) transducers with captive, fully compensated, externally pressurized, linear air bearings offer exceptional accuracy and reliability of performance for precision gaging applications. In addition to the advantage of a low positive side-deflection characteristic, the air bearing provides, for all practical purposes, negligible friction. As a result, reliable operation at gaging forces as low as 0.1 gram (0.001 newton) is possible. Details of design and fabrication are discussed for several different geometries and sizes of transducers. Dynamic operational characteristics are presented along with the tests used to characterize performance criteria of the units. Application experience with these transducers used in several gaging systems concludes that the transducer can be effectively used to improve the accuracy of many gaging systems, while providing increased versatility and reliability of operation. (auth)

COMPLETE OR PARTIAL COLLECTIONS OF ERDA REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, International Atomic Energy Agency (IAEA)
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Brussels, European Atomic Energy Community (Euratom)
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atómica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd.
Hamilton, Ontario, McMaster University
Ottawa, National Research Council

CONGO, REPUBLIC OF
Kinshasa, Trico Nuclear Center

DENMARK
Risö, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Karlsruhe, Zentralstelle für Atomkernenergie Dokumentation
Munich, Technische Universität

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Institute

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Ispra, Cetis Library
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energía Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Boston Spa, Wetherby, Yorkshire, British Library Lending Division
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra, Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
British Library Lending Division
Boston Spa, Wetherby, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

UNITED STATES
ATOMIC ENERGY COMMISSION
P. O. BOX 62
OAK RIDGE, TENNESSEE 37830

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U. S. ATOMIC ENERGY COMMISSION

U.S.MAIL

POSTAGE AND FEES PAID
GOVERNMENT PRINTING OFFICE

U.S.MAIL

XEROX UNIVERSITY MICROFILMS
SERIALS DEPT.
300 N. ZEEB ROAD
ANN ARBOR, MI 48106

1

Announcing the publication of a new bibliography

SOLAR ENERGY: A Bibliography (TID-3351)

This 356-page bibliography contains 3545 references to scientific and technical information on the economic utilization of solar energy to generate electricity and to heat and cool buildings. References are arranged chronologically in broad subject categories, such as Resources and Availability, Economics, Solar Energy Conversion, and Solar Collectors and Concentrators. Personal author, subject, and report number indexes are included. The computer-selected references were compiled and indexed by the U. S. Atomic Energy Commission's Office of Information Services, Technical Information Center (published in December 1974).

TID-3351 is available from
National Technical Information Service
U. S. Department of Commerce
Springfield, Virginia 22161

Paper Copy: $10.60

Microfiche: $2.25 (domestic)
$3.75 (foreign)